DEPARTMENT OF ENVIRONMENTAL QUALITY

KATHLEEN BABINEAUX BLANCO
GOVERNOR

MIKE D. McDANIEL, Ph.D.
SECRETARY

AUG 2 8 2006

CERTIFIED MAIL 7004 1160 0000 3793 7778
RETURN RECEIPT REQUESTED

Veronica Toussaint White, Director
Department of Sanitation
City of New Orleans
1340 Poydras Street, Suite 750
New Orleans, Louisiana 70112

RE: ADMINISTRATIVE ORDER
Gentilly Landfill "Type III"
AGENCY INTEREST NO. 1036

Dear Ms. White:

Pursuant to the Louisiana Environmental Quality Act (La. R.S. 30:2001, et seq. and particularly La. R.S. 30:2011(D)(6), (D)(14), La. R.S. 30:2033), the attached **ADMINISTRATIVE ORDER** is hereby served on **City of New Orleans (Gentilly Landfill "Type III").**

Any questions concerning this action should be directed to Robert Thomas at (225) 219-3056.

Sincerely,

Chuck Carr Brown, Ph.D.
Assistant Secretary

Attachment

c: Amid Metro Partnership, LLC.
Eddie Williams, FEMA
Mike Park, US Corps of Engineers

STATE OF LOUISIANA
DEPARTMENT OF ENVIRONMENTAL QUALITY

IN THE MATTER OF	*	
GENTILLY LANDFILL "TYPE III"	*	
ORLEANS PARISH	*	
	*	
	*	
	*	**AGENCY INTEREST NO. 1036**
	*	
PROCEEDINGS UNDER THE LOUISIANA	*	
ENVIRONMENTAL QUALITY ACT,	*	
La. R.S. 30:2001, ET SEQ.	*	

ADMINISTRATIVE ORDER

The following **ADMINISTRATIVE ORDER** is issued to the City of New Orleans, concerning Gentilly Landfill "Type III", (Gentilly or the facility) by the Louisiana Department of Environmental Quality (the Department or DEQ), under the authority granted by the Louisiana Environmental Quality Act (the Act), La. R.S. 30:2001, et seq., and particularly by La. R.S. 30:2011(D)(6), (D)(14), and La. R.S. 30:2033.

FINDINGS OF FACT

I.

Gentilly is a Type III landfill as defined in LAC 33:VII.115 located at 10200 Almonaster Avenue, Orleans Parish. It is owned by the City of New Orleans and operated by Amid Metro Partnership, LLC.

II.

As a Type III landfill, Gentilly is authorized pursuant to LAC 33:Part VII to accept *construction and demolition debris*, (C&D debris) *woodwastes*, and *yard waste* as defined in LAC 33:VII.115.

III.

The Department issued a Declaration of Emergency and Administrative Order dated August 30, 2005, and subsequent amendments (6th Amendment, dated June 26, 2006) in response to the devastation caused by Hurricane Katrina. It authorized the disposal of uncontaminated construction and demolition debris in permitted Type III landfills and sites that have been authorized by the Department for such disposal. The Declaration of Emergency and Administrative Order stated that for purposes of the order, "construction and demolition debris shall be the material indicated in Appendix D of this Declaration." Appendix D allowed the following "hurricane generated materials" for disposal at a "permitted construction and demolition debris (C&D) landfill":

- Nonhazardous waste generally considered not water-soluble, including but not limited to metal, concrete, brick, asphalt, roofing materials, sheet rock, plaster, lumber from a construction or demolition project, and other building or structural materials;
- Furniture, carpet, and painted or stained lumber contained in the demolished buildings;
- The incidental admixture of construction and demolition debris with asbestos-contaminated waste (i.e., incidental asbestos-contaminated debris that cannot be extracted from the demolition debris); and

- Yard waste and other vegetative matter.

IV.

As a result of Hurricane Katrina, it is estimated that 55 million cubic yards of debris has been generated in the Katrina impacted parishes. In response to the volume of debris generated, it is anticipated that the amount of hurricane generated materials to be directed to Gentilly may exceed the rate of disposal generally associated with C&D landfills and originally anticipated for this landfill.

V.

The Department and Louisiana Environmental Action Network (LEAN) have entered into a Consent Judgment, dated March 16, 2006, to settle East Baton Rouge Parish Suit Number 537,649, filed by LEAN challenging the Department's decision to utilize Gentilly Landfill for disposal of hurricane-generated debris.

VI.

The Consent Judgment provides that the Department shall limit daily intake at the Gentilly Landfill to 19,000 cubic yards per day during the time preceding the issuance of a decisional document and require an adequate number of spotters to be present on the working face of the landfill during operation of the facility. The Department also agreed to fashion a plan for groundwater monitoring and require the facility to develop a surface water monitoring or sampling plan. To implement these Consent Judgment provisions, the Department issued Administrative Order Number dated April 3, 2006 (AO) to the City of New Orleans concerning the Gentilly landfill.

VII.

The facility submitted a groundwater monitoring plan in response to the Department's AO; the plan is attached hereto. The plan provided the location of monitor wells, well details, sampling procedures and frequencies, analytical parameters, monitoring data evaluation, and reporting procedures for site groundwater.

VIII.

The AO also required the facility to make a determination whether groundwater makes contact with a surface water body. If it was determined that groundwater related to the facility operations discharges into surface water, Gentilly was required to submit a plan for monitoring discharges of groundwater into the surface water. The plan was submitted, consisting of three surface water sampling ports, screened between three feet to eight feet below the ground surface, which will intercept the shallow perched water at the site.

IX.

To comply with other provisions of the Consent Judgment, a third party investigator was contracted by the Department to evaluate slope stability of the south face of the final landfill elevation and determine any effect on the Mississippi River Gulf Outlet (MRGO) levee. The attached report "Slope Stability Analysis – Gentilly Landfill," determined the safe slope configuration for various waste height and loading rates.

ADMINISTRATIVE ORDER

Based on the foregoing, the City of New Orleans, Gentilly Type III Landfill is hereby Ordered to:

I.

Install inclinometers along the southern slope of the landfill in accordance with the attached groundwater monitoring plan.

II.

Limit the weekly gate rate of un-compacted C&D waste accepted for disposal at Gentilly to 210,000 cubic yards initially, and gradually increase the weekly gate rate to 280,000 cubic yards provided inclinometer readings and visual readings confirm landfill stability. Daily intake shall not exceed 50,000 cubic yards per day.

III.

Apply waste in the landfill by lifts that do not exceed a thickness of twenty –five (25) feet over the entire disposal area, prior to the placement of succeeding lifts.

IV.

Implement the attached Groundwater Monitoring Plan providing the location of monitor wells, well details, sampling procedures and frequencies, analytical parameters, monitoring data evaluation, and reporting procedures for site groundwater.

V.

Implement the attached Surface Water Monitoring /Sampling Plan consisting of three surface water sampling ports which will intercept the shallow perched water at the site.

VI.

The Department shall have the authority to halt, conduct or direct any tasks required by this Administrative Order and/or any response actions or portions thereof when conditions present an immediate risk to public health or welfare or the environment. To the maximum extent feasible, the Department shall allow the Gentilly to take any response action required pursuant to this clause.

VII.

Gentilly shall submit all correspondence and other documents to be submitted pursuant to this Administrative Order (including work plan[s] and report[s]) to the following addresses or to such other addresses as the Department hereafter may designate in writing:

Mr. Bijan Sharafkhani, P.E., Administrator
Waste Permits Division
Department of Environmental Quality
P.O. Box 4313
Baton Rouge, Louisiana 70821-4314

VIII.

Gentilly shall be excused from performing the activities called for in the Work Plan(s), within the time limits and in the manner specified in the schedules included in the work plan(s), if such performance is prevented or delayed by circumstances which constitute *force majeure*, as determined by the Department. For purposes of this Administrative Order, *force majeure* is any circumstance including weather, acts of God, and other circumstances arising from causes beyond Gentilly's reasonable control despite Gentilly's due diligence and good faith efforts. In the event of *force majeure*, the time for performance of any activity delayed by the *force majeure* shall be extended for the time period of the delay attributable to the *force majeure* event and the time for performance of any activity dependent upon the delayed activity shall be similarly extended. Gentilly shall notify the Department in writing as soon as reasonably possible but not later than fifteen (15) calendar days after Gentilly becomes aware of a circumstance which may delay or prevent (or has delayed or prevented) performance of any activity under the Work Plan(s). The notice shall state the cause and anticipated length of the delay, the measures taken by Gentilly to prevent or minimize such delay, and a timetable outlining when such measures were or will be taken.

IX.

Except for Paragraphs II, III and IV, the requirements of Administrative Order dated April 3, 2006 are revoked.

X.

This **ADMINISTRATIVE ORDER** is effective upon receipt.

Baton Rouge, Louisiana, this 28th day of August, 2006.

Chuck Carr Brown, Ph.D.
Assistant Secretary
Office of Environmental Services

Copies of correspondence should be sent to:

Louisiana Department of Environmental Quality
Office of Environmental Services
Waste Permits Division
P.O. Box 4313
Baton Rouge, LA 70821- 4313
Attention: Mr. Bijan Sharafkhani, P.E.

DEQ LOUISIANA

DEPARTMENT OF ENVIRONMENTAL QUALITY

KATHLEEN BABINEAUX BLANCO
GOVERNOR

MIKE D. McDANIEL, Ph.D.
SECRETARY

AUG 2 8 2006

CERTIFIED MAIL 7004 1160 0001 9950 5273
RETURN RECEIPT REQUESTED

Veronica Toussaint White, Director
Department of Sanitation
City of New Orleans
1340 Poydras Street, Suite 750
New Orleans, Louisiana 70112

RE: DECISION FOR UTILIZATION of
Gentilly Landfill "Type III"
Agency Interest Number 1036
Orleans Parish

Dear Ms. White:

Pursuant to the Louisiana Environmental Quality Act (La. R.S. 30:2001, et seq. and particularly La. R.S. 30:2011(D)(6), (D)(14), and La. R.S. 30:2033), the attached Decision for Utilization of Gentilly Landfill "Type III" for the disposal of hurricane generated Construction and Demolition debris is hereby served on the City of New Orleans.

Any questions concerning this action should be directed to Robert Thomas at (225) 219-3056.

Sincerely,

Chuck Carr Brown, Ph.D.
Assistant Secretary

Attachment

c: Amid Metro Partnership, LLC.
Eddie Williams, FEMA
Mike Park, US Corps of Engineers

ENVIRONMENTAL **SERVICES**
: PO BOX 4313, BATON ROUGE, LA 70821-4313
P:225-219-3181 F:225-219-3309
WWW.DEQ.LOUISIANA.GOV

STATE OF LOUISIANA

DEPARTMENT OF ENVIRONMENTAL QUALITY

OFFICE OF ENVIRONMENTAL SERVICES

IN THE MATTER OF	*
	*
	* **DECISION FOR**
	* **UTILIZATION OF GENTILLY**
GENTILLY LANDFILL "TYPE III"	* **LANDFILL "TYPE III" FOR THE**
AI# 1036 / D-071-0264 / P-0375	* **DISPOSAL OF HURRICANE**
ORLEANS PARISH	* **GENERATED DEBRIS**
	*
	*
	*
	*
	*
PROCEEDINGS UNDER THE LOUISIANA	*
ENVIRONMENTAL QUALITY ACT,	*
La. R.S. 30:2001 <u>et seq.</u>	*

This document provides the Louisiana Department of Environmental Quality's (LDEQ or Department) justification for authorizing the continued operation and utilization of the Gentilly Landfill "Type III" (Gentilly or facility) in Orleans Parish, Louisiana for the disposal of hurricane generated construction and demolition (C&D) debris. An "IT" Analysis is not required for issuance of emergency authorization. This document fulfills the necessary requirements of Article IX, Section 1 of the Louisiana Constitution and as required by the Consent Judgment in Suit # 537,649 filed in the 19th Judicial District Court for the Parish of East Baton Rouge. The

LDEQ will provide public notice of this decision and an opportunity for public comment. In accordance with the Consent Judgment, the public comment period will be not less than 30 days. The LDEQ will review and consider the public comment and may revise the final decision in light of such comments.

I. GENERAL BACKGROUND

On August 29, 2005, Hurricane Katrina struck Louisiana, causing widespread damage within numerous parishes, including Orleans Parish. By State of Louisiana Proclamation No. 48 KBB 2005, the Governor declared on August 26, 2005, that a state of emergency exists in Louisiana, as Hurricane Katrina posed an imminent threat, carrying severe storms, high winds and torrential rain that may cause flooding and damage to private property and public facilities and threatened the safety and security of the citizens of the state of Louisiana. By State of Louisiana Proclamation No. 54 KBB 2005, the Governor extended the state of emergency due to the extreme damage caused by Hurricane Katrina and the continuing disaster and emergency conditions in the affected areas. On August 29, 2005, the Federal Emergency Management Agency (FEMA) issued a Disaster Declaration, FEMA-1603-DR, covering south Louisiana.

On August 30, 2005, the Secretary of the LDEQ exercised the legal authority granted to him pursuant to the provisions of Louisiana Revised Statutes 30:2001 *et seq.*, and particularly La. R.S. 30:2033 and 2011(D)(6), and issued a Declaration of Emergency and Administrative Order wherein he declared that an emergency exists, and that certain measures were necessary to prevent irreparable damage to the environment and serious threat to life or safety throughout the designated emergency areas, including Orleans Parish. This Emergency Declaration was amended on September 3, 2005; November 2, 2005; November 17, 2005; January 13, 2006; March 31, 2006; and more recently on June 29, 2006. Each Emergency Declaration contains certain measures specifically authorized by the LDEQ and determined necessary to respond to the emergency.

To address the unprecedented disaster, federal, state and local agencies engaged in formalizing a process to enable the State of Louisiana, the United States Army Corps of Engineers (Corps) and the Federal Emergency Management Agency (FEMA) to comprehensively manage large scale and complex debris clearance, management and disposal. The Emergency Declaration provided that disposal or processing of any solid waste in or at un-permitted facilities or sites, may be authorized by the Department on a case-by-case basis. Parish and municipal governments identified and requested the use of potential debris management sites. The LDEQ evaluated the sites, and if satisfactory, authorized them as temporary debris management sites. The sites were designated for specific purposes: woodwaste burning operations; woodwaste and C&D grinding; construction and demolition debris staging or disposal; staging of boats, vehicles, and/or white goods; and the staging of household hazardous waste.

Based upon Corps situation reports (as of July 24, 2006), there remains to be processed approximately 3.5 million cubic yards of vegetative debris and 5.6 million cubic yards of demolition debris in Orleans Parish. Additional debris not yet included in the Corps situation reports is also expected. The City of New Orleans (City) has identified approximately 15,000 structures that are slated to be demolished. ("red tagged"). Another eighty thousand (80,000) structures have been "yellow tagged" (identified by the City as flooded) in Orleans Parish. FEMA recently published updated flood elevation maps. As a result of these maps, most of the yellow tagged structures may need to be raised by an average of three feet in order to meet the new base flood elevation requirements. LDEQ estimates that for economic reasons, 50% of those eighty thousand (80,000) structures will be demolished then rebuilt, rather than raising them to the new standards. A typical structure generates 300-350 cubic yards of debris when demolished. Accordingly, the Department conservatively estimates that an "additional" twenty million (20,000,000) cubic yards of demolition debris will be generated for disposal in Orleans parish before rebuilding can begin. It is also estimated that another 15,000 structures in St. Bernard Parish will be demolished.

In the LDEQ's experience, a C&D facility can safely dispose of up to fifty-thousand (50,000) cubic yards a day. Once that threshold is exceeded, landfill operations are subject to safety concerns. The gravity of the emergency situation created by Hurricane Katrina has required regulatory flexibility and a consideration of the timeframe for debris removal. With the authorization of Gentilly Landfill combined with the existing Highway 90 Landfill, the LDEQ's estimated timeframe for completion of debris removal is as follows: using 50,000 cubic yards a day (one landfill) would require 14 months to dispose of the debris generated by the demolition of the structures. With the use of two landfills, the time frame would be essentially halved to 7 months. Therefore, to expedite the removal and disposal of the remaining C & D hurricane-generated and demolition debris associated with demolition activities in the area in and around Orleans Parish and particularly in the New Orleans East and Ninth Ward Areas, the continued availability of Gentilly Landfill is essential to the cleanup effort.

In order to provide for a more efficient disposal of the exceptional volume of hurricane debris, the Emergency Declaration and Order(s) issued by the LDEQ expanded the scope of the definition of C&D debris. Appendix D of the Emergency Declaration and Order listed material to be considered as C&D debris:

- Nonhazardous waste generally considered not water-soluble, including but not limited to metal, concrete, brick, asphalt, roofing materials, sheet rock, plaster, lumber from a construction or demolition project, and other building or structural materials;
- Furniture, carpet, and painted or stained lumber contained in the demolished buildings;
- The incidental admixture of construction and demolition debris with asbestos-contaminated waste. (i.e., incidental asbestos-contaminated debris that cannot be extracted from the demolition debris); and
- Yard waste and other vegetative matter.

Although the Emergency Declaration and Order has expanded the scope of C&D debris for hurricane generated debris, the material otherwise included is not considered to be a threat to the environment.

II. GENTILLY LANDFILL

In June of 2002, the LDEQ received a permit application from the City of New Orleans to construct and operate the Gentilly landfill for the disposal of Construction & Demolition debris and woodwaste. The site is approximately 200 acres and is located at 10200 Almonaster Avenue in New Orleans, Louisiana. After determining that the permit application was technically complete and complied with the requirements of the Solid Waste Regulations, a public notice was published noting the technical completeness of the application and inviting the public to comment on the application. Although the public notice was published in both the *Times Picayune* and *The Advocate*, the LDEQ received no public comments or requests for hearing on the application.

On December 28, 2004, the LDEQ Assistant Secretary of the Office of Environmental Services, issued Standard Permit P-0375 to the City of New Orleans for the construction and operation of the Gentilly landfill. The landfill is designated as a Type III landfill; Type III landfills are authorized for the disposal of C&D debris and woodwaste. The Gentilly landfill was constructed over a previously closed municipal landfill. This "piggyback" concept, i.e., the placement of one landfill on top of another, has been practiced not only in Louisiana but also throughout the country. The goal behind this technique is to fully maximize the utilization of the area that has already been disturbed for disposal of waste, thus preserving pristine areas. Under the "piggyback" concept, the existing cover system over the closed landfill acts as a liner system for the landfill on top.

The Solid Waste Regulations require that construction and demolition debris landfills be constructed over an area with low permeable soils. The existing cover system of the closed municipal landfill at Gentilly, meets this requirement. In fact, during the consideration of Standard Permit P-0375, the department did not receive any public comment that placement of waste on top of the closed landfill would cause any adverse environmental impact.

It is important to note that groundwater and soil samples were collected from the Gentilly site on November 9, 2005 and analyzed by EE&G, a Corps contractor, as a part of initial site assessment prior to use by the Corps. The data from these samples, as well as from the City's groundwater monitoring plan for Gentilly, demonstrate that there has been no adverse environmental impact from the old landfill. Additionally, as a part of the initial permit application, several borings were drilled through the waste for geotechnical analysis to determine the suitability of constructing a Type III facility on the old landfill. The data indicated that the waste has undergone biodegradation. This can be attributed with great certainty to the partial closure and the aerobic conditions in the landfill. Also, on November 11, 2005, EPA conducted a separate assessment and found no concerns regarding groundwater or any other contamination concerns.

In addition to the technical adequacy of the Gentilly landfill for hurricane generated construction and demolition debris disposal needs, other considerations for the LDEQ's decision to utilize the Gentilly landfill for disposal were explored. The Gentilly landfill is in close proximity to the hurricane devastated areas and the bulk of the hurricane generated construction and demolition debris. Moreover, this landfill is in a remote location. The surrounding area along Almonaster Boulevard, off of which the Gentilly landfill sits, is heavily wooded and except for some industrial development, is relatively undeveloped. As such, waste haulers have readily accessible roads to the landfill.

A. CONSIDERATION OF ALTERNATIVES:

ALTERNATE SITES:

In addition to Gentilly, two other sites were initially considered as emergency disposal sites for hurricane generated construction and demolition debris for the New Orleans area; Recovery 1, and Amid. Subsequent to the Gentilly authorization, the LDEQ also authorized the operation of a landfill located at 16600 Chef Menteur Highway.

1.) <u>Recovery 1:</u> The Recovery 1 landfill is a municipal solid waste landfill which was closed in the mid 1990's. The site is surrounded by water bodies on its north, east and south boundaries. The only areas available for disposal would be on the top of the landfill and an adjacent area to the west. After further evaluation, disposal on top of the landfill was rejected due to its height, landfill stability, and concern over imposition of additional loads. The area to the west is smaller than 20 acres and consequently would not provide sufficient air space for the large quantity of hurricane generated construction and demolition debris.

2.) **<u>Amid:</u>** According to the City of New Orleans permit application submitted to the LDEQ in 2002 for the proposed Gentilly landfill, the Gentilly landfill was intended to replace the AMID Type III construction and demolition landfill that was nearing the end of its design life and its subsequent closure. According to verbal communications with the operator of the facility, as of July 20, 2006, AMID, at its normal pre-Katrina waste acceptance rate, had only three months of air space remaining. Therefore, this facility was clearly inadequate as a disposal option for the massive amounts of hurricane generated construction and demolition debris in the area.

3.) **<u>Chef Menteur C&D Disposal Facility (Chef):</u>** At the request of the City of New Orleans, this facility was authorized as an emergency disaster clean-up site by the Department on April 26, 2006. However, the City of New Orleans issued a "Cease and Desist" letter to Waste Management of Louisiana L.L.C., the operator of the facility, as a result of its failure to obtain a Conditional Use Permit. The facility is no longer in operation and is not receiving waste.

ALTERNATIVE PROJECTS:

Utilizing existing landfills located in Jefferson Parish (Riverbirch and Highway 90) was also considered as an alternative ("no build" option). Riverbirch Landfill is a Type I & II landfill, while Highway 90, like Gentilly, is a Type III C&D landfill. A Type I landfill is a facility used for the disposal of industrial solid waste; a Type II landfill is a facility used for the disposal of residential or commercial solid waste. Both of these landfills are located in Jefferson Parish.

Although the LDEQ, pursuant to the Emergency Declaration, authorizes the disposal of material not technically included in the regulatory definition of construction and demolition debris, (i.e., furniture, carpet) the composition of the waste still is of minimal risk to the environment. Notably, all Type III landfill disposal facilities are authorized to accept such waste pursuant to the Declaration of Emergency and Administrative Order.

Since C&D debris is the waste stream to be disposed at Gentilly, utilization of a Type I and II landfill for disposal of such debris would unnecessarily increase the cost of disposal. (It is generally more expensive to dispose of waste at a Type I/II facility rather than a Type III landfill). Moreover, the sheer volume of the hurricane generated C&D debris requiring disposal in the most expeditious and environmentally sound manner as possible under the circumstances, renders utilization of Type I or II landfills unfeasible. This is because placement of debris in landfills is done sequentially—one cell is constructed and used for disposal and when that cell fills up, another is constructed. Because the construction of cells for Type I and II landfills requires much more time and expense (largely because of the liner and leachate collection systems construction requirements) than the construction of Type III landfill cells, the cell construction time will be outpaced by the volume of debris received and requiring disposal. Additionally, the future capacity of Type I and Type II landfills in the greater New Orleans metropolitan area will be drastically reduced. Type I and II landfill disposal capacity should be reserved for industrial and municipal solid waste respectively.

The Highway 90 facility is also a Type III facility accepting hurricane generated C&D debris pursuant to the Emergency Declaration and Order. It is subject to the same design requirements and standards as the Gentilly landfill. Consequently, it would not provide any greater environmental protection.

However, the transportation of debris to these landfills from New Orleans East is less efficient for two primary reasons. One, being the location of the debris from the subject facilities (distance will be further discussed in another section of this document) and the other being traffic congestion in route to these facilities. Waste transporters have confirmed that four or five trips per day can be made hauling waste to Gentilly landfill as compared with two trips per day to Jefferson Parish facilities. Thus, diverting debris to these landfills would increase waste hauling time and expense, and worsen the traffic problems in the New Orleans metropolitan area. Second, the Riverbirch and Highway 90 facilities are located in areas of Jefferson Parish that are currently populated. Not using the Gentilly landfill would significantly hinder the recovery of the City by delaying the disposal of remaining debris.

Alternatives to landfilling were considered and utilized for the management of hurricane generated debris. With respects to Orleans Parish, approximately thirty (30) sites were utilized for debris management. These sites were used for the burning of vegetative debris (open burning and air-curtain destructors), chipping / grinding of vegetative and C&D debris and the staging of white goods, woodwaste and construction and demolition debris. These methods were and are useful tools in the cleanup process for Orleans and surrounding parishes. However, when considering the scope and degree of C&D debris generated from Hurricane Katrina and associated flooding, the rate at which these projects are able to process C&D debris (the primary waste steam accepted at Gentilly), would limit their viability as the only options for debris management. These options would still ultimately require disposal of waste in a landfill. As a sole debris management option, burning and grinding of this material alone, would be impracticable, inefficient and result in extending the timeframe of the clean-up and recovery effort.

Additionally, there was opposition from citizens, environmental groups, and local and federal government concerning the burning of C&D debris. The opposition was primarily based on environmental and human health concerns relative to this method of reduction. There has not been extensive research in the matter of burning C&D debris and the potential health and environmental risks associated with such. Further, there are National Emission Standards for Hazardous Air Pollutants (NESHAP) concerns, regarding the burning and grinding of C&D debris.

Resource recovery was considered a nonviable option on a large scale because of the massive amount of debris and the need for expedient disposal. Due to the mixed nature of the waste involved, composting was not a practical alternative. Composting is useful for vegetative debris but not C&D debris, particularly at the magnitude required. Therefore, the landfill option was chosen as a primary debris management option. The landfill option has proven to be reliable, expedient, protective of human health and welfare and the environment, and economically feasible.

B. MITIGATING MEASURES AND POTENTIAL AND REAL ADVERSE ENVIRONEMTAL EFFECTS:

As stated earlier, the Gentilly landfill permit application has undergone an extensive permitting process which included careful technical scrutiny to ensure that the facility met all applicable legal and technical requirements for permitting. The original design was based on an operational plan and sequential placement of waste to control storm water run-on/runoff. However, due to the abnormally high rate of hurricane generated construction and demolition debris transported to the site for disposal, operational changes had to be made. These changes affected the fill sequence and the construction schedule. Specifically, although temporary berms were initially constructed to control the run off, permanent berms have now been constructed around the operating area of the landfill and will be extended as the operating area expands.

Analysis of Potential Impacts on Nearby Levees

A third party investigation was conducted to evaluate the slope stability of the south face of the final landfill elevation to determine any effect on the Mississippi River Gulf Outlet (MRGO) levee. This investigation resulted in a document entitled, **"Slope Stability Analysis – Gentilly Landfill"** (see attachment). The investigation included additional soil borings and laboratory analysis to determine the engineering and physical properties of the subsurface soils. This information was used to provide engineering analyses to determine the safe slope configurations for various waste height and loading rates. In the analysis, several loading rate options were considered. The first option assumed a loading rate of 6000 tons/day (in place based on the unit weight of 65 lb/cu ft) or 30,000 cubic yards/day (gate rate based on the unit weight of 13 lb/cu ft). In this option the lowest factor of safety against failure was approximately 1.35. Generally a factor of safety of greater than 1.0 represents a stable slope. The second option consisted of determining the maximum loading rate based on a factor of safety of 1.2. The analyses indicate that this factor of safety corresponds to an in place loading rate of 12,000 tons/day or 60,000 cu yd/day gate rate. The LDEQ concurs in the conclusion as contained in this document, and concludes that the operation of this facility will have no adverse effects on the MRGO levee.

Installation of Inclinometers

As an additional means of ensuring that this landfill will not impact the MRGO levee system and to detect any subsurface lateral movements, the facility has been installing inclinometers along its southern slope, paralleling the MRGO. A total of 10 inclinometers will be installed in a phased manner and in accordance with the landfill progression. The inclinometers will be placed at approximately 400 ft intervals adjacent to the highest landfill elevation and then increased to 600 – 800 ft intervals which correspond to lower elevations. These inclinometers will be installed to a depth of approximately 80-90 ft and will be terminated in stiff, highly plastic clays. By installing this system, the lateral movements of the landfill can be monitored. In the event such movement is observed, the operator will have several options available to control or prevent further movement. These options include cessation of waste placement in the affected area or the relocation of existing waste. A copy of the inclinometer installation and monitoring plan has been provided as an attachment.

Ground Water Monitoring Plan

Gentilly submitted a Groundwater Installation and Monitoring Plan, dated July 7, 2006, to the Department for its review. This plan provides the location of the monitoring wells, well details, sampling procedures and frequencies, analytical parameters, monitoring data evaluation, and groundwater data reporting procedures for the subject facility. This plan (see attachment) requires eleven (11) monitoring wells around the perimeter of the landfill in order to provide early warnings of potential relevant chemical changes in groundwater quality at the facility.

The groundwater monitoring wells will have 10-foot long screens and will monitor the first continuous water-bearing permeable strata. Groundwater level measurements and groundwater sampling will be recorded quarterly for the first year and semi-annually thereafter. The sampling parameters will include volatiles, semi-volatiles, cations, and anions. For a specific list of parameters please see Attachment 2 of the Groundwater Monitoring Plan.

The results of the detection analysis will be compared to the background trend analysis for each sampled parameter. A report identifying any parameter(s) that exceed the upper boundary level will be provided to the Department. If the data indicates that an impact to groundwater has occurred, the facility will notify the Department as specified in the Solid Waste Rules and Regulations. The Department has carefully reviewed and approved the plan and is of the opinion that it will add another level of security in protecting the environment relative to the subject site.

Waste Segregation

Waste segregation is conducted at the site of generation, before the debris is hauled for disposal, in order to prevent unauthorized waste from entering disposal facilities. Types of waste being segregated include household hazardous waste, asbestos containing material, electronic waste, small motorized equipment, and white goods. EPA contractors are trained to handle each stream in a manner protective of human health and the environment. Curbside waste is examined for the unauthorized waste described above, segregated from the authorized waste stream, accumulated and transported to an EPA managed collection facility. Once inside the collection facilities, environmental technicians consolidate and manifest the household hazardous waste streams for transportation to the appropriate permitted disposal facilities.

C. COST BENEFIT:

The social and economic benefits of having a disposal facility in New Orleans East outweigh the environmental-impact costs. The majority of C&D debris generated in Orleans Parish that requires disposal is located in the eastern portion of the Parish. In order to have the most efficient and expeditious clean-up effort possible, at least one disposal facility is required in this area. Gentilly Landfill meets the ideal location characteristics for this recovery effort and offers an economically feasible option, in comparison to the alternative of hauling New Orleans East debris to Jefferson Parish.

Transportation outside the metropolitan area will require expenditure of additional costs (fuel, wear and tear on vehicles and roads, driver transit time) and imposition of an additional burden on both traffic flow and the environment. Diversion of debris will give rise to increased volume at other authorized facilities, which has the potential to increase wait time for disposal. The increased transportation costs incurred by haulers (fuel and time) may, in turn, affect the profitability of waste hauling. This may result in a decrease in number of qualified transporters / trucks, which would delay the clean-up effort. This scenario is supported and has previously been experienced by contractors engaged in the debris mission.

In addition, FEMA currently pays 100% of the FEMA eligible debris mission costs in Orleans Parish until December 31, 2006. Without Gentilly landfill, the clean-up recovery effort would certainly not be completed before this December 2006 deadline. After the deadline it is expected that the City would incur 10% of the costs associated with debris mission costs (inclusive of costs associate with C&D debris removal, hauling and disposal). This would result in an added economic hardship to the City, and perhaps the State of Louisiana.

An increase in transportation costs will likely result in the increase of illegal dumping. Private haulers paid by the job with no disposal facility in the immediate area, may choose to illegally dump the debris. This will result in an additional drain on the LDEQ's and City's resources for increased surveillance, enforcement, and clean-up activities.

Without Gentilly landfill, debris would have to be diverted to other facilities, most likely in Jefferson Parish. In the LDEQ's experience, a C&D facility can safely dispose of up to fifty-thousand (50,000) cubic yards a day. Once that threshold is exceeded, landfill operations are subject to safety concerns. First, the increased potential for heavy truck traffic to Jefferson Parish could lead to major traffic congestion on highways, bridges, and entry and exit points at the receiving landfill, creating a nuisance and/or hazard for the general public. Second, the working face of a landfill is small, and the increased number of trucks and waste exceeding the 50 thousand cubic yards per day could endanger the spotters' safety and ability to spot and pull out unauthorized waste. A greater number of trucks in this space would increase the risk of on-site collisions with other trucks and heavy equipment and could result in injuries to workers.

Additionally, delays in curbside pickup of solid waste currently being experienced, would increase without Gentilly landfill, and would potentially increase curbside commingling of uncollected household garbage mixed with C&D debris. This would result in an increased risk to public health and safety as the commingled material stays in-place, awaiting final disposal. The longer this material remains in an uncontrolled environment, especially during hurricane season, the greater the potential risk to the public. Expeditious disposal of all waste streams must be a priority.

Notably, in order to properly evaluate the impact of diverting debris to other landfills, LDEQ scientists utilized EPA's MOBILE6 emissions model to determine daily excess air pollutant emissions from hauling C&D debris to an alternative landfill site location in Jefferson Parish. The alternative site used was the Highway 90 C&D landfill in Jefferson Parish. The geographic centroid for construction and demolition debris was calculated to be approximately 1.0 mile west of St. Bernard northwest parish line in Orleans Parish. This point is the center most point of the total mass or volume of the hurricane generated construction and demolition debris. Gentilly landfill is approximately 8 miles from this point while Highway 90 landfill is approximately 23 miles. Thus, one round trip for hurricane generated construction and demolition debris waste haulers would be 16 miles for disposal at Gentilly as opposed to 46 miles for disposal at Highway 90. It should also be noted that as a result of the increased distance and travel time, waste haulers' truck emissions of volatile organic compounds, nitrogen oxides, carbon monoxide, particulate matter, sulfate and ammonia would increase.

IV. OTHER MATTERS

A seventeen (17) acre area of Gentilly has not been closed in accordance with regulatory requirements. Though not in operation, this area has been scheduled for final closure. The final closure cover system will include (from top to bottom), compacted Class II subgrade, a geosynthetic clay liner (GCL) and a minimum 12-inch thick vegetated granular protective layer. At the same time, this component system will serve as an alternate liner for the disposal of construction demolition debris associated with the facility. This cover system satisfies the final cover requirements of LAC 33:VII.721.D.3.a (i). In addition, this system satisfies the liner requirements of Section 719.D.2.

As an additional safety precaution, the LDEQ has required that the facility provide an adequate number of spotters at the working face of the landfill during hours of operation through an Administrative Order issued April 3, 2006.

To address financial assurance concerns, a trust fund has been established for the benefit of the Louisiana Department of Environmental Quality for the payment of the closure costs of the Gentilly Landfill. The operator of the Gentilly landfill, pursuant to a contract with the City of New Orleans, is responsible for the closure of the landfill. The operator has deposited funds in this trust, which is based upon the amount of cubic yards of waste taken in by the landfill as of May 31, 2006.

Surface Water Monitoring / Sampling Plan

Any potential discharge/impact of groundwater to surrounding surface water bodies will be monitored by three surface water sampling ports (see attached map for sampling locations). These ports will consist of eight foot long slotted PVC pipes, screened between three feet to eight feet below the ground surface which will intercept the shallow perched water at the site.

These ports will be sampled quarterly for three years for the indicator parameters in accordance with the Effluent Limitations Guidelines, Pretreatment Standards, and New Source Performance Standards for the Landfills Point Source Category. A list of indicator parameters is provided in the attachment.

V. GENTILLY LANDFILL'S AUTHORIZATION TO OPERATE

In light of Hurricane Katrina and its aftermath, and based upon the above justification, careful and deliberate review of all environmental law, relevant LDEQ emergency and administrative guidance, and specific analytical reports, groundwater plans, and site evaluation information, the LDEQ hereby authorizes operation of Gentilly landfill in accordance with the Administrative Orders dated April 3, and August 28, 2006.

VI. APPEALS OR REQUEST FOR REVIEW

In accordance with the provisions of La. R.S. 2033, any appeal or request for review of the authorization for the utilization of the Gentilly Landfill "Type III" in Orleans Parish, Louisiana for the disposal of hurricane generated Construction and Demolition debris is required to be brought in an action for injunctive relief filed in the Nineteenth Judicial District Court for the Parish of Baton Rouge.

Chuck Carr Brown, Ph.D.
Assistant Secretary

8/28/06
Date

REPORT OF

GEOTECHNICAL INVESTIGATION

GENTILLY LANDFILL
SLOPE STABILITY ANALYSES
NEW ORLEANS (ORLEANS PARISH), LOUISIANA

FOR

LA DEPARTMENT OF ENVIRONMENTAL QUALITY
BATON ROUGE, LOUISIANA

STE
Soil Testing Engineers, Inc.
Geotechnical, Environmental & Materials Consultants

Baton Rouge, LA • Biloxi, MS • New Orleans, LA

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PHONE (504) 835-2593 • FAX (504) 835-2982
www.steofla.com

25 July 2006

LA Department of Environmental Quality
P.O. Box 4303
Baton Rouge, LA 70821

Attn: Mr. Bijan Sharafkhani, P.E.

Re: Report of Geotechnical Investigation
Gentilly Landfill
Slope Stability Analyses
New Orleans (Orleans Parish), Louisiana
STE File: 06-1046

Dear Bijan,

Transmitted are three copies (one bound and two unbound) of our engineering report covering a geotechnical investigation for the subject project. Our findings, together with the analyses and conclusions based on them, are submitted in the attached report.

Thank you for asking us to perform these services. It has been a pleasure working with you on this project and we look forward to serving you again in the future.

Sincerely,
SOIL TESTING ENGINEERS, INC.

David O'Kelly for:

DR. GORDON P. BOUTWELL, JR., P.E.
President

Chad M Poche
CHAD M. POCHE, P.E.
Vice President

STATE OF LOUISIANA
CHAD M. POCHE
REG. No. 27667
REGISTERED PROFESSIONAL ENGINEER
IN
CIVIL ENGINEERING

bbl

GEOTECHNICAL, ENVIRONMENTAL & MATERIALS CONSULTANTS
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STE
Soil Testing Engineers, Inc.

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Soil Testing Engineers, Inc.

REPORT OF
GEOTECHNICAL INVESTIGATION
GENTILLY LANDFILL
SLOPE STABILITY ANALYSES
NEW ORLEANS (ORLEANS PARISH), LOUISIANA

1.0 EXECUTIVE SUMMARY

STE has completed an exploration and evaluation of the subsurface conditions for proposed C & D waste (Type III Facility) stacking at the Gentilly Landfill located off Almonaster Avenue in New Orleans, Louisiana. Work for this project was authorized by the Louisiana Department of Environmental Quality (LA DEQ).

The Gentilly Landfill was a closed Type II landfill, roughly 5300 feet long (E-W) and 1200 feet wide (N-S), lying parallel to and about 180 feet north of the toe of the MRGO/GIWW north levee. It was originally filled and capped at about El 5 (feet MSL). After Hurricane Katrina, the landfill was reopened for Type III wastes. These now cover about the western third of the landfill area to near El 20. The anticipated final height of the landfill is to El 140. Temporarily, the height is being limited to El 60. The exterior side slope is 1(V):4(H).

Permitting, including slope stability analyses, was performed by Metroplex Industries, Inc. (now Metroplex Core) of Houston, Texas. Their geotechnical report, Attachment 8 to the Permit Application (revised July 2004) was furnished to STE. Stability analyses for the south (MRGO/ICWW) face are included as Figure No. 8 of the Metroplex geotechnical report. It indicates a minimum safety factor of 1.9 against failure of the waste mass at El 140, with a safety factor of 3.1 against a failure involving the MRGO/ICWW levee.

These analyses assumed that filling was slow enough that all excess pore water pressures would dissipate, so that Metroplex used solely a drained (frictional only) strength condition for the underlying soils. The filling rate for the landfill was furnished to STE by Metroplex as averaging some 30,000 to 40,000 cu.yd./day until recently. Since then, we understand the rate is about 10,000 cu. yd./day (approximately 6,000 tons per day).

Subsequently, the Metroplex analyses were questioned by the New Orleans District of the U. S. Army Corps of Engineers (USACE). According to information furnished to STE, the USACE requires that the slope stability analyses use only the soils' initial (preconstruction) undrained shear strengths. Since this assumption will lead to unrealistically low shear strengths (especially under the landfill and levee), it will also lead to unrealistically low safety factors for the landfill waste stacks.

The objective of this study is to determine the stability of the south face of the final landfill configuration, especially with respect to effects on the MRGO/ICWW levee.

Data was available from the Metroplex borings of 2002, and also from the original investigations by Eustis Engineering Company in 1980-1982. In general, the natural soils consist of a soft to medium clay crust to about El -5, followed by extremely soft and very soft clays and peats to around El -25. The soils increase in strength there to soft clays, which extend to near El -65 to El -75. Here, stiff Pleistocene clays begin. There are layers of loose silts in the upper soils, and some loose to firm sands at greater depths.

One (1) cone pentrometer sounding (CPT) and three (3) undisturbed soil borings were performed by STE for this investigation. The borings and CPT sounding were completed to depths ranging from 70 to 80 feet below the existing ground surface.

In addition to the information obtained from our soil borings and CPT sounding, information obtained from the previous investigations performed at the site was used for our analyses. The most recent data consists of our soil borings and CPT sounding and 2 CPT soundings taken by others through the U.S. EPA. In general, survey information indicates ground surface at our boring locations is at approximate El 0.

Engineering analyses consisting of slope stability analyses were performed. The findings of our investigation, together with our evaluations and conclusions, are presented in this report. Various figures consisting of a boring location plan, subsoil cross sections, shear strength computations, and the results of our slope stability analyses follow the report.

Appendix A contains the completed logs of the STE undisturbed soil borings. The results of consolidation tests and consolidated, undrained, triaxial compression tests follow the soil boring logs in Appendix A. In addition, the results of the direct simple shear tests and consolidation tests performed by others for the U.S. EPA are contained within Appendix A. The results of the CPT soundings performed by STE and the soundings provided by the U.S. EPA are provided in Appendix B. Appendix C contains various calculations as they pertain to projected strength gain of the subsoils.

2.0 SCOPE

One (1) CPT sounding and three (3) undisturbed soil borings were performed by STE to determine soil stratigraphy and develop engineering properties of the subsurface soil conditions. Selected samples were tested in STE's LA DEQ approved soils laboratory in Baton Rouge to develop the engineering and physical properties of the subsurface soils. This information was used to provide engineering analyses to determine safe slope configurations for various waste heights and loading rates.

3.0 FIELD PROCEDURES

As discussed, three (3) undisturbed soil borings and one (1) CPT sounding were performed by STE to depths ranging from 70 to 80 feet below ground surface. The undisturbed soil borings and CPT sounding were performed using truck and ATV-mounted, rotary type, drilling equipment.

The locations of the soil borings and CPT soundings at the site are provided on Figure 1 of this report. Detailed descriptions of the methods utilized in the field for the soil borings and CPT soundings are provided in Appendices A & B, respectively.

4.0 LABORATORY TESTING

Soil mechanics laboratory testing was performed on selected samples from the undisturbed soil borings. Certain samples from the various strata were tested in the laboratory to determine their pertinent physical and engineering characteristics. The samples and types of tests performed were selected by a geotechnical engineer to develop information necessary for appropriate analyses.

The testing program was conducted in general accordance with ASTM and LA DEQ methods and was conducted at STE's LA DEQ approved soils laboratory in Baton Rouge, LA. The results of the laboratory testing program are summarized and included in Appendix A.

5.0 SUBSURFACE SOIL CONDITIONS

Cross section subsoil profiles were created from the findings of the soil borings and CPT soundings. Figures 2 through 5 provide various subsoil cross sections.

6.0 PROJECT CONSIDERATIONS

This section provides information regarding the project that is pertinent to the geotechnical investigation. This information includes a description of the project as provided to this office and a statement of the limitations inherent to an investigation of this nature.

6.1 Project Description

The Gentilly Landfill was a closed Type II landfill, roughly 5300 feet long (E-W) and 1200 feet wide (N-S), lying parallel to and about 180 feet north of the toe of the MRGO/GIWW north levee. After Hurricane Katrina, the landfill was reopened for Type III wastes. These now cover about the western third of the landfill area to near El 20. The anticipated final height of the landfill is to El 140. Temporarily, the height is being limited to El 60. The waste will be placed on 4 (horizontal) to 1 (vertical) slopes.

The objective of this study is to determine the stability of the south face of the final landfill configuration, especially with respect to effects on the MRGO/ICWW levee. Both present loading rates (estimated to be approximately 6,000 tons per day) and maximum allowable loading rates (as dictated by slope stability analyses of the waste stack) were evaluated.

6.2 Limitations

The analyses and recommendations presented in this report are based on the preceding project information and the results of the subsurface investigation. While it is not likely that conditions will differ greatly from those observed in the soil borings and CPT soundings, it is always possible that variations can occur between or away from the borehole or CPT locations.

If it becomes apparent during construction that subsurface conditions differing significantly from those discussed in this report are encountered, this office should be notified at once so that their effects can be determined and any remedial measures necessary be prescribed. Also, should the nature of the project change, these recommendations may have to be re-evaluated.

This report has been prepared for the exclusive use of LA DEQ for the purpose of providing geotechnical engineering design recommendations. The recommendations provided in this report are site specific and are not intended for use at any other site or for any other facility.

7.0 ENGINEERING ANALYSES

7.1 Slope Stability

Slope stability analyses were performed to investigate the stability of waste slopes. Our slope stability analyses were performed using the computer program Slope/W, Version 5.20, by Geo-Slope International, Ltd.

For our stability analyses, the soil strength and density properties defined from our investigation were utilized. Strength gain due to levee and waste placement and soil consolidation was considered. Strength gain of the underlying soils occurs over time as fill is placed and the soils consolidate. A summary of our assumptions for the primary items of concern is presented below.

Waste:
A significant amount of research has been conducted on the subject of slope stability modeling techniques for waste fills. An undrained shear strength of 100 psf and internal friction angle of 23 degrees are considered appropriate strength properties for C & D waste and were used in our analyses. An assumed unit weight of 65 pcf for the waste stack was also used in our analyses.

Strength Gain:
Due to the placement of fill and waste over time, the underlying subsoils have consolidated and gained strength. Extensive research has been performed in the study of strength gain effects. Our analyses closely matched and follow previous studies. The results of the consolidation tests, consolidated undrained triaxial tests, and the direct shear tests were used in conjunction with shear strength and overburden ratios. Various calculations made by STE as they relate to strength gain are included as Appendix C of this report.

In general, Su/P ratios of 0.16 to 0.37 were calculated at the various boring and CPT locations. Closer analysis of the CPT data and direct simple shear tests as well as the laboratory shear strength data indicate a Su/P ratio of 0.28 is applicable for this site and project. Therefore, a Su/P ratio of 0.28 was used for our analysis.

The strength data and analysis of shear strength versus effective overburden for Borings L-1, L-2, L-3, and CB-3 are provided on Figures 6 through 9. In addition, a summary of the direct simple shear test data, as provided by the U.S. EPA, is provided on Figure 10.

Waste Stacking:
The first option analyzed utilized a current loading rate on the order of 6,000 tons/day. Given this rate, we estimate waste is currently at a height of approximately El 26 (2006). Projected fill heights of El 62 in 2009 and El 140 in 2012 were also analyzed. The waste will be placed on approximate 4 (Horizontal) to 1 (Vertical) slopes.

The second option requested to be analyzed focused on the maximum amount of waste that could be placed while maintaining a safe slope for the waste stack. In general, our analyses for this case indicate a waste stack to El 60 after the first year (2007), waste to El 85 after year 2 (2008), and waste to El 140 after year 3 (2009). We estimate these heights correspond to an approximate loading rate of 12,000 tons per day. This calculated loading rate (as based on fill heights) should be verified by LA DEQ.

7.2 Results of Analyses

Preliminary evaluations indicated the soil conditions and layering encountered at Boring L-2 appeared to govern the analyses. Therefore, analyses using the current waste loading rate (6,000 tons per day) and Boring L-2 properties were made.

The results of these analyses are provided on Figures 11 through 15. Projected waste stack configurations in the years 2006 (current), 2009 (three year), and 2012 (6 year) were analyzed. In addition to presenting the critical failure arc (lowest computed factor of safety), failure arcs for the waste stack into the levee are also shown. As shown on Figures 11 through 15, the projected waste stack and levee appear stable with respect to slope failure.

Figures 16 through 21 provide the results of our analyses for a potential maximum loading rate. In general, our analyses increased the waste stack height to the maximum point where the minimum factor of safety against failure was approximately 1.2. The same rates of consolidation and overburden pressures used for a waste loading rate of 6,000 tons per day were used for these analyses as well. Therefore, the analyses presented on Figures 16 through 21 should be considered conservative.

8.0 CONSULTATION

Often during final design and/or construction, questions can arise which are not specifically covered in the report. They can normally be handled by a brief phone call or conference with the designers.

FIGURES

APPENDIX B

CPT-FIELD PROCEDURES

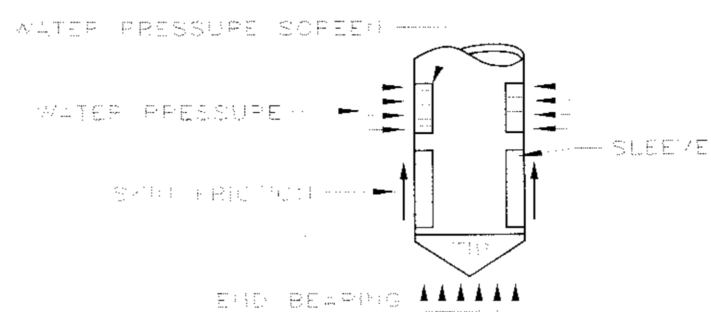
The following paragraphs describe the field and laboratory procedures used for this investigation for the cone penetrometer soundings (CPT). CPT logs are included with this appendix. The logs included with this appendix are from both STE's activities and the soundings made for the U.S. EPA by others.

B.1 FIELD EXPLORATION

One (1) CPT sounding was made by STE to a depth of 70 feet below ground surface in order to supplement the undisturbed soil borings. Due to its ability to continuously measure in-situ shear strength of the underlying subsoils, the CPT soundings provide invaluable data with regards to analyzing soft cohesive soils.

STE's soundings were made on 10 May 2006. The soundings made for the U.S. EPA were performed on 17 May 2006. The approximate locations of the soundings are shown on the Boring Plan, Figure 1.

For the CPT equipment, the sensing tip is pushed continuously into the soil by a hydraulic ram. Data is transmitted from the CPT sensor to the operator as it occurs for real time evaluation. The force is transmitted from the rig through small diameter rods. As illustrated in the sketch below, the tip has three sensing units. It measures simultaneously the resistance at the end of the tip (end-bearing), the resistance along the vertical sides of the sleeve above the tip (skin-friction), and the groundwater pressure just above the sleeve.



SKETCH - CPT TIP

The absolute values of the tip and sleeve resistance can be related to the soil shear strength. This ratio (sleeve/tip) depends on the ratio of soil cohesion (c) to its friction [Tan(φ)]. A high sleeve/tip ratio indicates a clayey soil, while a low ratio indicates a sandy soil. The soil stratigraphy shown on the CPT plots is identified using Campanella and Robertson's Simplified Soil Behavior Chart.

APPENDIX A

APPENDIX A

FIELD (UNDISTURBED SOIL BORINGS) AND LABORATORY TESTING PROCEDURES

The following paragraphs describe the field and laboratory procedures used for this investigation for the undisturbed soil borings. Completed soil boring logs are included with this appendix. The boring logs provide the field and laboratory data collected.

A.1 FIELD EXPLORATION

Three (3) undisturbed soil borings were made by STE for this project to investigate subsurface conditions. The borings were completed at the 80 foot depth below ground surface. The borings were drilled on 2 and 9 May 2006. The approximate locations of the borings are shown on the Boring Plan, Figure 1.

A.1.1 Drilling Methods

The borings were drilled with truck and ATV-mounted, rotary-type drilling equipment. The soil borings were advanced using a nominal four-inch diameter short flight auger. This technique allowed the proper borehole advancement to secure the appropriate samples (see "Sampling Procedures") and allowed the observation of the presence of free water in the boreholes. Upon completion of the borings, the boreholes were grouted full depth in accordance with Louisiana regulations.

A.1.2 Sampling Procedures

Soil samples were obtained continuously within the upper 60 feet of the ground surface. Continuous sampling was performed to provide detailed soil information. Below the 60 foot depth, the samples were obtained at three to five feet on center.

In these cohesive and semi-cohesive soils, relatively undisturbed samples were secured using a three-inch diameter, thin-wall steel tube sampler. In this sampling procedure, the borehole is advanced to the desired level, and the tube is lowered to the bottom of the boring. It is then pushed about two feet into the undisturbed soil in one continuous stroke. The sample and tube are retrieved from the borehole and detached from the drill string.

The sample is extruded by a hydraulic piston onto a rigid sample catcher to minimize disturbance. The sample is then visually classified. The classification includes description of soil color, strength estimates, identification of structural conditions (layering, seams, etc.) and variations (organics, oxide inclusions, etc.). A pocket penetrometer strength test is performed. Any disturbed portions are discarded, and the sample is sealed to minimize disturbance and moisture loss during transportation to STE's LA DEQ approved soils laboratory.

In the less cohesive materials, standard penetration tests were performed. These tests provide a measure of the in situ characteristics of the soil and secure a disturbed sample. In this test, a 2 inch OD, 1.37 ID, heavy-walled "split spoon" sampler is driven into the undisturbed soil at the bottom of the borehole with a drop hammer weighing 140 pounds and having a stroke of 30 inches. It is first seated 6 inches, then driven an additional two, six-inch increments. The "Penetration Resistance" is the number of such blows required to drive the spoon the last 12 inches. It is recorded on the boring log in the following manner:

24 b/f
(7-9-15)

where the figures in parenthesis indicate the number of blows required for each 6 inch increment.

A.2 LABORATORY PROCEDURES

Certain samples from the various strata were tested in the laboratory to determine their pertinent physical characteristics. The samples and types of tests performed were selected by a geotechnical engineer to develop information necessary for appropriate analyses. The testing program was conducted in general accordance with ASTM and LA DEQ methods and is described below.

A.2.1 Strength Tests

The strength characteristics of the various soil strata are important for geotechnical engineering analyses. Twenty-nine (29) unconsolidated, undrained, triaxial compression (UU) tests (ASTM D 2850), and four (4) consolidated, undrained, triaxial compression (CU) tests (ASTM D 4767) were performed to develop this data. The testing procedures also include determination of the moisture content and wet and dry density of the sample.

The results of the UU compression tests are tabulated in the laboratory data portion of the soil boring logs under the column heading "Compressive Strength". The results of the CU tests are provided on separate plots following the boring logs in this Appendix. The moisture content and dry density data are tabulated in the subsequent two columns within the laboratory data portion of the logs. A summary of the CU test results is provided on Table A-2 of this Appendix.

A.2.2 Classification Tests

In order to classify the soils more definitely than can be done by field methods, twenty-three (23) Atterberg Limit determinations (ASTM D 4318) were made. The Atterberg Limits data consist of Liquid Limit (LL), Plastic Limit (PL), and Plasticity Index (PI). The relationship among these variables is as follows:

$$PI = LL - PL$$

The Atterberg Limits data is provided within the laboratory portion of the logs under the headings "Liquid Limit" and "Plasticity Index".

A.2.3 Consolidation Tests

Five (5) consolidation tests (ASTM D 2435) were performed to analyze the compressibility characteristics of the subsoils. The consolidation test results are shown on separate plots following the boring logs. A summary of the consolidation test results is provided on Table A-1 of this Appendix.

DESCRIPTION OF TERMS AND SYMBOLS USED ON SOIL BORING LOG

STE

Soil Testing Engineers, Inc.

FIELD DATA				LABORATORY DATA								
Ground Water Level	Depth (feet)	Samples	Field Test Results	Compressive Strength (tsf)	Water Content (%)	Dry Unit Weight (pcf)	Atterberg Limits LL	PL	PI	Other	Soil Type	DESCRIPTION

Depth (feet): 5, 10, 15, 20, 25, 30, 35, 40

3.5 (P)

13 b/f
(3-7-6)

Ground Water Levels

Long-Term Depth
Depth to water after boring is completed (time noted).

Short-Term Depth
Depth to water after initial water encountered prior to proceeding with boring (time noted).

Initially Encountered
Depth where free water was initially encountered during augering.

Sampling/Field Data

Undisturbed
3" dia. Tube sample

Pocket Penetrometer (P)
Penetration resistance (tons/sq. ft.).

Torvane (T)
Shearing resistance (tons/sq. ft.)

Split Spoon
Std. penetration test

Std. Penetration
No. of blows per foot (blows per each six inch increments).

Auger
Disturbed (auger) collected in accordance with ASTM D-1452.

No Recovery
Sampling attempted but no sample retrieved.

Description

Classifications are based on visual observations by field & lab representatives as well as results of laboratory data (when available).

Laboratory Data

Compressive Strength
Value based on peak compressive strength. Determined by unconfined compression test unless otherwise noted.

Dry Unit Weight
As determined by method similar to ASTM D-2937.

Water Content
As determined by pertinent portions of ASTM D-2216.

Atterberg Limits
LL : Liquid Limit
PL : Plastic Limit
PI : Plasticity Index
(= Liquid Limit - Plastic Limit)

Other
Results of other tests such as consolidation, permeability, grain size or notes associated with testing program.

Soil Type
Graphical representation of soil type. In accordance with USCS Symbols.

Ground Water Level Data	Boring Advancement Method	Notes
	Boring Abandonment Method	

Form LOGTERMS

Strata Boundaries May Not Be Exa

Stability Analysis
Gentilly Landfill
New Orleans, LA

LOG OF SOIL BORING L-1

STE
Soil Testing Engineers, Inc.
Sheet 1 of 2

File: 06-1046
Date: 05/02/06
Logged by: K. Moody
Driller: D. Robinson
Rig: CME 75

LA Dept of Environmental Quality
Baton Rouge, LA

LELAP Certificate No. 02052

Location: Lat. 30° 00' 06.8"
Long. 89° 58' 48.9"
Surface Elevation: +0.5 (ft., NGVD)

FIELD DATA			LABORATORY DATA								
Ground Water Level	Depth (feet)	Field Test Results	Compressive Strength (tsf)	Water Content (%)	Dry Unit Weight (pcf)	Atterberg Limits LL	Atterberg Limits PL	Atterberg Limits PI	Other	Soil Type	Description
		2.5 (P)									Medium tan and gray CLAY (CH)
▼		1.2 (P)									Medium dark gray and brown CLAY (CH) w/organic matter and shell fragments
	5	0.7 (P)	0.33t1	48	67	65	25	40			Soft gray CLAY (CH) w/organic matter
		0.2 (P)									Very soft dark gray CLAY (CH) w/organic matter and wood fragments
		0.2 (P)	0.12t2	63	57	81	22	59			
▽	10	1.5 (P)									Medium gray CLAY (CH) w/trace of organic matter
		1.0 (P)	0.38t3	39	79	43	22	21			
	15	0.4 (P)	0.27t4	265	18	377	231	146	CS		Soft black and dark brown PEAT (PT) w/large wood fragments
		0.5 (P) Tube									
		0.2 (P)									
	20	0.4 (P)									Very soft gray CLAY (CH) w/trace of organic matter -- w/sand seams and layers at 20 to 24 ft.
		0.5 (P)	0.18t5	60	62	77	25	52			
	25	0.5 (P)									
		0.4 (P)	0.17t6	67	55	83	25	58			
		0.5 (P)									-- w/sand seams at 28 to 30 ft.
	30	0.5 (P) Tube									
		0.5 (P)	0.23t7	69	58	83	35	48	CS		
	35	0.7 (P)									Soft gray CLAY (CH)
		0.5 (P)									
		1.0 (P)									-- w/sand seams at 38 to 42 ft.
	40										

Continued Next Page

Ground Water Level Data

▽ Free water first encountered

▼ Water level after 15 mins.

Boring Advancement Method

4" Nom. Dia. Short Flight Auger:
0 to 10 ft.
4" Dia. Rotary Wash:
10 to 80 ft.

Boring Abandonment Method

Tremie grouted bottom-to-top with 4% cement/bentonite grout

Notes

t: Unconsolidated, Undrained Triaxial Compression Test
Lateral Pressure (psi)
t1 = 2.2 t2 = 2.8
t3 = 4.35 t4 = 2.2
t5 = 6.7 t6 = 7.1
t7 = 9.1
CS: See Consolidation Curve

Strata Boundaries May Not Be Exact

LOG01R 061046.GPJ LOG01.GDT 06/21/06

Stability Analysis
Gentilly Landfill
New Orleans, LA

LOG OF SOIL BORING L-1

STE
Soil Testing Engineers, Inc.

Sheet 2 of 2

LA Dept of Environmental Quality
Baton Rouge, LA

LELAP Certificate No. 02052

File: 06-1046
Date: 05/02/06
Logged by: K. Moody
Driller: D. Robinson
Rig: CME 75

Location: Lat. 30° 00' 06.8"
Long. 89° 58' 48.9"
Surface Elevation: +0.5 (ft., NGVD)

FIELD DATA				LABORATORY DATA								
Ground Water Level	Depth (feet)	Samples	Field Test Results	Compressive Strength (tsf)	Water Content (%)	Dry Unit Weight (pcf)	Atterberg Limits LL	Atterberg Limits PL	Atterberg Limits PI	Other	Soil Type	Description
			0.7 (P)									Soft gray CLAY (CH) -- w/sand seams at 40 to 42 ft.
			1.0 (P)	0.48t8	69	56	101	38	63			-- jointed at 42 to 46 ft.
	45		0.5 (P)									
			0.7 (P)									-- w/shell fragments at 46 to 48 ft.
			0.5 (P)									
	50		0.4 (P)									
	55		2.0 (P)	0.77t9	32	91	55	25	30			Medium greenish-gray CLAY (CH) -- w/calcareous nodules at 54 to 56 ft. -- slickensided at 54 to 58 ft.
			2.0 (P)									
	60		2.5 (P)									Stiff greenish-gray CLAY (CH), slickensided
	65		2.5 (P)	1.58t10	49	74						
	70		2.0 (P)									-- w/sand seams at 68 to 70 ft.
	75		1.7 (P)									Firm gray SILTY SAND (SM) w/clay streaks
	80		54 b/f 21-26-28		26					GS		Very dense gray SILTY SAND (SM)

Boring completed at 80 ft.

Ground Water Level Data

Free water first encountered

Water level after 15 mins.

Boring Advancement Method

4" Nom. Dia. Short Flight Auger:
0 to 10 ft.
4" Dia. Rotary Wash:
10 to 80 ft.

Boring Abandonment Method

Tremie grouted bottom-to-top with 4% cement/bentonite grout

Notes

t: Unconsolidated, Undrained Triaxial Compression Test
Lateral Pressure (psi)
t8 = 11.0 t9 = 23.0
t10 = 22.0
GS: Particle Size Analysis
Gravel = 0%, Sand = 52%

Strata Boundaries May Not Be Exact

LOG01R 061046.GPJ LOG01.GDT 06/21/06

Stability Analysis
Gentilly Landfill
New Orleans, LA

LA Dept of Environmental Quality
Baton Rouge, LA

LOG OF SOIL BORING L-2

STE
Soil Testing Engineers, Inc.

LELAP Certificate No. 02052

File: 06-1046
Date: 05/09/06
Logged by: M. Machen
Driller: Ironhorse
Rig: Buggy

Location: Lat. 30° 00' 08.5" Long. 89° 58' 30.2"
Surface Elevation: -0.2 (ft., NGVD)

Ground Water Level	Depth (feet)	Field Test Results	Compressive Strength (tsf)	Water Content (%)	Dry Unit Weight (pcf)	LL	PL	PI	Other	Description
		1.0 (P)								Medium tan and gray SILTY CLAY (CL) w/roots
		1.0 (P)								Medium gray CLAY (CH) w/wood fragments -- w/3-inch sand layer at 2.5 ft.
▼	5	0.2 (P)	0.30t1	36	78	55	20	35		Soft dark gray CLAY (CH) w/sand pockets and organic matter
▽		Tube								WOOD w/Very soft gray CLAY (CH)
		No (P)		458	11	487	288	199	CU	Very soft black and dark brown PEAT (PT)
	10									
		Tube								
	15	0.2 (P)	0.11t2	259	21	202	88	114		Very soft dark gray and dark brown ORGANIC CLAY (OH) w/PEAT (PT)
		0.2 (P)								
		5 b/f 2-3-3							GS	Loose gray SANDY SILT (ML) w/clay layers
	20	No (P)								
		0.2 (P)								Very soft gray CLAY (CH) -- w/silt layers at 22 to 24 ft.
	25	Tube	0.14t3	49	64	64	28	36	CS	
		0.2 (P)								
		0.2 (P)								
	30	0.2 (P)								
		0.2 (P)	0.09t4	76	55	60	29	31		-- w/silt laminations at 32 to 34 ft.
	35	0.2 (P)								-- w/silt seams at 34 to 36 ft.
		0.3 (P)								Soft gray CLAY (CH) w/sand laminations
		0.3 (P)	0.25t5	59	62	81	25	56	CS	
	40									

Continued Next Page

Ground Water Level Data

▽ Free water first encountered

▼ Water level after 15 mins.

Boring Advancement Method

4" Nom. Dia. Short Flight Auger: 0 to 10 ft.
4" Dia. Rotary Wash: 10 to 80 ft.

Boring Abandonment Method

Tremie grouted bottom-to-top with 4% cement/bentonite grout

Notes

t: Unconsolidated, Undrained Triaxial Compression Test
Lateral Pressure (psi)
t1 = 3.7 t2 = 3.5
t3 = 8.0 t4 = 10.0
t5 = 12.1
CU: Consolidated, Undrained Triaxial Compression Test - See Table A-2
GS: Particle Size Analysis
Gravel = 0%, Sand = 27% Silt = 44%, Clay = 29%
CS: See Consolidation Curve
Strata Boundaries May Not Be Exact

Stability Analysis
Gentilly Landfill
New Orleans, LA

LA Dept of Environmental Quality
Baton Rouge, LA

LOG OF SOIL BORING L-2

STE
Soil Testing Engineers, Inc.

LELAP Certificate No. 02052

File: 06-1046
Date: 05/09/06
Logged by: M. Machen
Driller: Ironhorse
Rig: Buggy

Location: Lat. 30° 00' 08.5"
Long. 89° 58' 30.2"
Surface Elevation: -0.2 (ft., NGVD)

Ground Water Level	Depth (feet)	Field Test Results	Compressive Strength (tsf)	Water Content (%)	Dry Unit Weight (pcf)	LL	PL	PI	Other	Description
		0.2 (P)								Very soft gray CLAY (CH) -- w/sand seams at 40 to 42 ft.
		0.3 (P)								
	45	0.2 (P)	0.14t6	64	60					-- w/sand layers at 44 to 48 ft.
		Tube								-- w/4-inch sand layer at 48 ft.
		1.0 (P)								Very soft greenish-gray CLAY (CH) w/sand seams and shell fragments
	50	1.0 (P)	0.18t7	67	56					
		0.2 (P)								
	55	~~2.7 (P)~~								Firm greenish-gray SILT (ML)
										Medium greenish-gray CLAY (CH)
		0.2 (P)	0.27t8	72	55	83	25	58		Soft dark gray CLAY (CH) w/silt laminations
		1.7 (P)								Stiff light gray and greenish-gray CLAY (CH)
	60									
		1.2 (P)	1.23t9	35	84					-- slickensided at 63 to 65 ft.
	65									
		2.0 (P)								Firm greenish-gray CLAYEY SILT (ML) w/clay seams
	70									
		1.2 (P)	0.85t10	31	86					Medium greenish-gray SILTY CLAY (CL) w/sand laminations and shell fragments
	75									
		No (P)								Firm greenish-gray SILTY SAND (SM)
	80									Boring completed at 80 ft.

Ground Water Level Data

▽ Free water first encountered
▼ Water level after 15 mins.

Boring Advancement Method

4" Nom. Dia. Short Flight Auger: 0 to 10 ft.
4" Dia. Rotary Wash: 10 to 80 ft.

Boring Abandonment Method

Tremie grouted bottom-to-top with 4% cement/bentonite grout

Notes

t: Unconsolidated, Undrained Triaxial Compression Test
Lateral Pressure (psi)
t6 = 13.3 t7 = 13.3
t8 = 14.7 t9 = 24.5
t10 = 28.3

Strata Boundaries May Not Be Exact

Stability Analysis
Gentilly Landfill
New Orleans, LA

LOG OF SOIL BORING L-3

STE
Soil Testing Engineers, Inc.

File: 06-1046
Date: 05/09/06
Logged by: K. Moody
Driller: D. Robinson
Rig: CME 75

LA Dept of Environmental Quality
Baton Rouge, LA

LELAP Certificate No. 02052

Location: Lat. 30° 00' 11.2"
Long. 89° 58' 01.3"
Surface Elevation: +0.6 (ft., NGVD)

Ground Water Level	Depth (feet)	Field Test Results	Compressive Strength (tsf)	Water Content (%)	Dry Unit Weight (pcf)	LL	PL	PI	Other	Description
		4.5 (P)								Very stiff tan and brown SILTY CLAY (CL) w/organic matter
		2.0 (P)	0.74t1	32	85					Medium tan and gray CLAY (CH) w/organic matter
	5	1.0 (P)								-- w/wood fragments at 4 to 6 ft.
▼		0.7 (P)	0.26t2	69	50	103	31	72		Soft dark gray CLAY (CH) w/organic matter and silt seams
▽		0.5 (P)								-- w/shell fragments at 8 to 10 ft.
	10	0.4 (P)	0.22t3	97	43	129	33	96		Very soft dark brown ORGANIC CLAY (OH) w/wood fragments
		0.5 (P) Tube								Very soft black and dark brown PEAT (PT)
	15	0.3 (P)								
		0.7 (P)		176	28	175	51	124	CU	Soft dark brown and gray ORGANIC CLAY (OH)
		0.5 (P)								Soft gray CLAY (CH) -- w/organic matter at 18 to 20 ft.
	20	0.7 (P) Tube								
		0.5 (P)	0.31t4	44	78					-- w/sand seams at 22 to 24 ft.
	25	0.7 (P)								Loose gray CLAYEY SAND (SC)
		0.5 (P)								
		1.0 (P)	0.99t5	33	87	28	26	2		-- w/shell fragments at 28 to 30 ft.
	30	1.5 (P)								
		1.7 (P)								Soft gray SILTY CLAY (CL) w/silt laminations
	35	0.5 (P)								
		1.0 (P)	0.43t6	30	90					
	40	1.0 (P)								

Continued Next Page

Ground Water Level Data

▽ Free water first encountered
▼ Water level after 15 mins.

Boring Advancement Method

4" Nom. Dia. Short Flight Auger: 0 to 10 ft.
4" Dia. Rotary Wash: 10 to 80 ft.

Boring Abandonment Method

Tremie grouted bottom-to-top with 4% cement/bentonite grout

Notes

t: Unconsolidated, Undrained Triaxial Compression Test
Lateral Pressure (psi)
t1 = 2.4 t2 = 4.1
t3 = 4.7 t4 = 11.0
t5 = 13.6 t6 = 17.0
CU: Consolidated, Undrained Triaxial Compression Test - See Table A-2

Strata Boundaries May Not Be Exact

LOG01R 061046.GPJ LOG01.GDT 06/21/06

Stability Analysis
Gentilly Landfill
New Orleans, LA

LA Dept of Environmental Quality
Baton Rouge, LA

LOG OF SOIL BORING L-3

STE
Soil Testing Engineers, Inc.
Sheet 2 of 2
LELAP Certificate No. 02052

File: 06-1046
Date: 05/09/06
Logged by: K. Moody
Driller: D. Robinson
Rig: CME 75

Location: Lat. 30° 00' 11.2"
Long. 89° 58' 01.3"
Surface Elevation: +0.6 (ft., NGVD)

FIELD DATA			LABORATORY DATA								
Depth (feet)	Samples	Field Test Results	Compressive Strength (tsf)	Water Content (%)	Dry Unit Weight (pcf)	Atterberg Limits LL	PL	PI	Other	Soil Type	Description
		0.7 (P)									Soft gray SILTY CLAY (CL) w/silt laminations
		1.0 (P)	0.49t7	36	82						Soft gray CLAY (CH) w/sand layers
45		1.0 (P)		51	67	79	24	55	CU		
		0.7 (P) Tube									
		0.9 (P)									
50		1.2 (P)							GS1		Loose grayish-blue SAND (SP) w/shell fragments
		0.9 (P)		23	100				GS2 CU		
55		No (P)									
		WOH									Very soft grayish-blue CLAY (CH), very shelly
60		1.0 (P)	0.17t8	26	90						Very loose grayish-blue CLAYEY SAND (SC) w/shells
65		1.5 (P)									Medium to stiff greenish-gray CLAY (CH), slickensided
70		2.5 (P)	0.74t9	52	71	96	27	69			
75		2.7 (P)									-- grayish-brown, w/silt laminations at 73 to 75 ft.
80		2.5 (P)	1.59t10	34	91	49	25	24			Stiff gray SILTY CLAY (CL)

Boring completed at 80 ft.

Ground Water Level Data

∇ Free water first encountered
▼ Water level after 15 mins.

Boring Advancement Method

4" Nom. Dia. Short Flight Auger: 0 to 10 ft.
4" Dia. Rotary Wash: 10 to 80 ft.

Boring Abandonment Method

Tremie grouted bottom-to-top with 4% cement/bentonite grout

Notes

t: Unconsolidated, Undrained Triaxial Compression Test
Lateral Pressure =(psi)
t7 = 18.4 t8 = 23.8
t9 = 24.8 t10 = 35.2
CU: Consolidated, Undrained Triaxial Compression Test - See Table A-2
GS: Particle Size Analysis
GS1: Sand = 92%
GS2: Gravel = 14%, Sand = 78%
WOH: Weight of Hammer

Strata Boundaries May Not Be Exact

LOG01R 061046.GPJ LOG01.GDT 06/21/06

GENTILLY LANDFILL
NEW ORLEANS, LA
TABLE A-1
SUMMARY OF CONSOLIDATION TESTS

BORING	DEPTH (ft)	LL (%)	PI (%)	W_o (%)	DD_o (pcf)	C'c (dec/cy)	C_v (ft^2/day) for Pressure Range (ksf)							Remarks
							.12 .25	.25 .50	.50 1.00	1.00 2.00	2.00 4.00	4.00 8.00	8.00 16.00	
L-1	15	377	146	265	18	0.36	0.066	0.060	0.034	0.023	0.012	0.007	0.004	STE
L-1	33	83	48	69	58	0.31	0.084	0.022	0.020	0.010	0.006	0.005	-	STE
L-2	14	224	179	180	27	0.29	0.009	0.010	0.012	-	-	-	-	EPA
L-2	25	64	36	56	66	0.16	0.107	0.090	0.061	0.043	0.059	0.053	0.038	STE
L-2	28	54	35	53	69	0.26	-		0.030	0.037	0.044	-	-	EPA
L-2	39	81	56	59	62	0.27	0.265	0.070	0.044	0.022	0.013	0.008	0.007	STE
L-2	48	95	70	79	52	0.26	-	0.009	0.024	0.021	0.018	-	-	EPA
L-3	14	73	50	64	61	0.21	-	0.006	0.009	0.022	0.026	0.024	-	EPA
L-3	22	57	39	55	70	0.21	-	-	-	-	-	-	-	EPA
L-3	48	95	68	69	57	0.30	-	0.003	0.006	0.015	0.021	0.062	-	EPA
CB-4	43	88	65	77	55	0.27	0.065	0.044	0.038	0.024	0.015	0.009	-	METROP.
CB-5	23	45	19	40	76	0.12	-	0.072	-	-	-	-	-	METROP.

LL = Liquid Limit (D 4318)
PI = Plas. Index (D 4318)
W_o = Initial Water Content (D 2216)
DD_o = Initial Dry Density (D 2937)

C'c = Compression Index: Δ (Strain/ Δ (log cycle stress) - (D 2435)
C_v = Coefficient of Consolidation (D 2435)

GENTILLY LANDFILL
NEW ORLEANS, LA
TABLE A-2
SUMMARY OF
CONSOLIDATED-UNDRAINED TRIAXIAL COMPRESSION TESTS
(with Pore Pressure Measurements)

BORING NO.	DEPTH (feet)	LL (%)	PI (%)	W_o (%)	DD_o (pcf)	STAGE	EFFECTIVE PRESSURES (KSF)			SOIL TYPE
							CONSOL. (P'c)	AT FAILURE (P'_3)	FAILURE SHEAR (τ_f)	
L-2	8-10	487	199	485	11	1	0.40	0.09	0.12	PT
						2	0.71	0.10	0.21	
						3	0.94	0.12	0.37	
L-3	16-18	175	124	179	28	1	0.58	0.10	0.15	OH
						2	0.94	0.20	0.33	
						3	1.37	0.39	0.46	
L-3	44-46	79	55	51	67	1	1.27	0.46	0.30	CH
						2	1.92	0.88	0.66	
						3	3.31	1.29	0.89	
L-3	52-54	-	NP	23	100	1	2.04	1.53	3.67	SP
						2	2.68	4.10	7.47	
						3	3.40	5.80	9.45	
CB-1	22	81	58	69	60	1	2.34	1.04	0.93	PT*
CB-5	22	45	19	41	75	1	2.34	0.49	1.35	PT*

* Test by Metroplex. Classified "Humus." CB-1 sample should be "CH" and CB-5 sample should be "CL".

LL = Liquid Limit (D 4318) W_o = Initial Water Content (D 2116) Soil Types USCS (D 2487)
PI = Plas. Index (D 4318) DD_o = Initial Dry Density (D 2937)
PRESSURE AT FAILURE = MINOR PRINCIPAL STRESS (p'_3)

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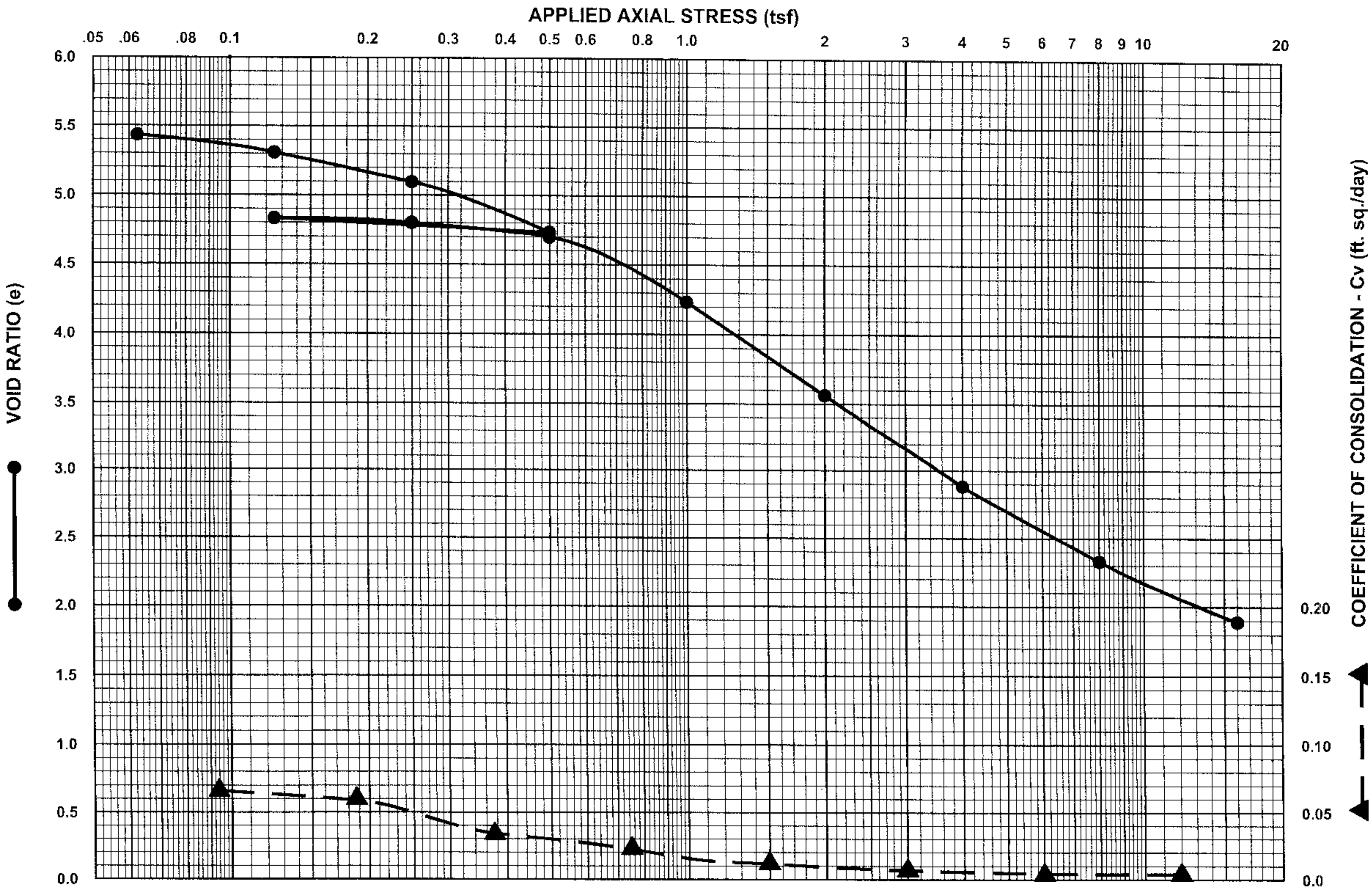

CONSOLIDATION TEST

SAMPLE IDENTIFICATION

BORING NO.: L-1
DEPTH (feet): 14-16
MATERIAL: Black & dark brown PEAT w/large wood fragments
FILE NO.: 06-1046

STE
Soil Testing Engineers, Inc.

CLASSIFICATION DATA

INITIAL MOISTURE CONTENT (%) = 218.3 LL = 377
INITIAL DRY DENSITY (lbs./cu.ft.) = 24.0 PL = 231
FINAL MOISTURE CONTENT (%) = 57.0 PI = 146
Eo = 5.477 Gs = 2.5 Assumed

FIGURE NO.:

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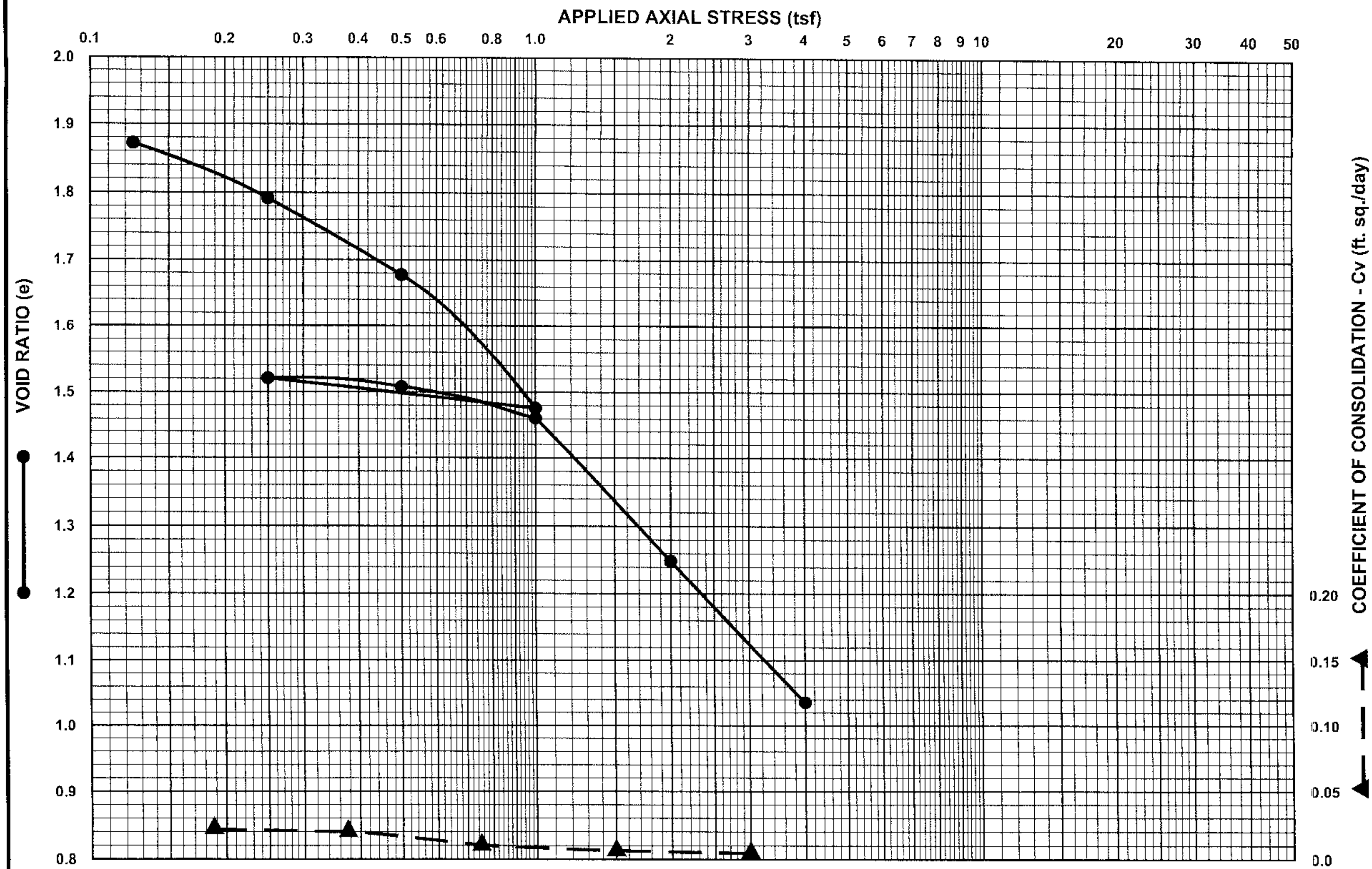
Jun 08, 2006 - 10:20am



CONSOLIDATION TEST

SAMPLE IDENTIFICATION

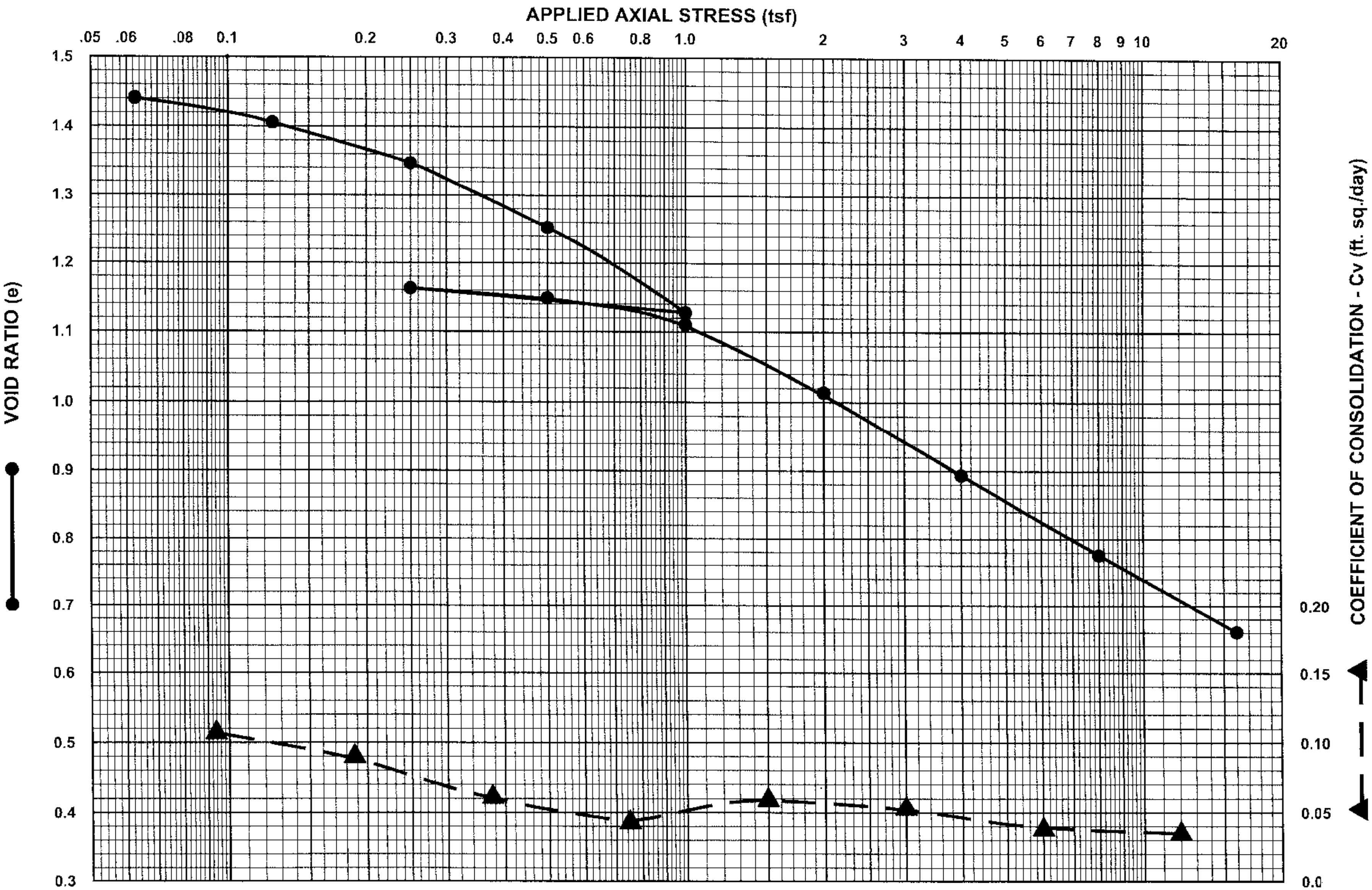
BORING NO.: L-1
DEPTH (feet): 32-34
MATERIAL: Gray CLAY
w/trace organic matter
FILE NO.: 06-1046

STE
Soil Testing Engineers, Inc.

CLASSIFICATION DATA

INITIAL MOISTURE CONTENT (%) = 70.8 LL = 83
INITIAL DRY DENSITY (lbs./cu.ft.) = 55.9 PL = 35
FINAL MOISTURE CONTENT (%) = PI = 48
Eo = 1.902 Gs = 2.6
Assumed

FIGURE NO.:



CONSOLIDATION TEST

SAMPLE IDENTIFICATION

BORING NO.: L-2
DEPTH (feet): 24-26
MATERIAL: Gray CLAY

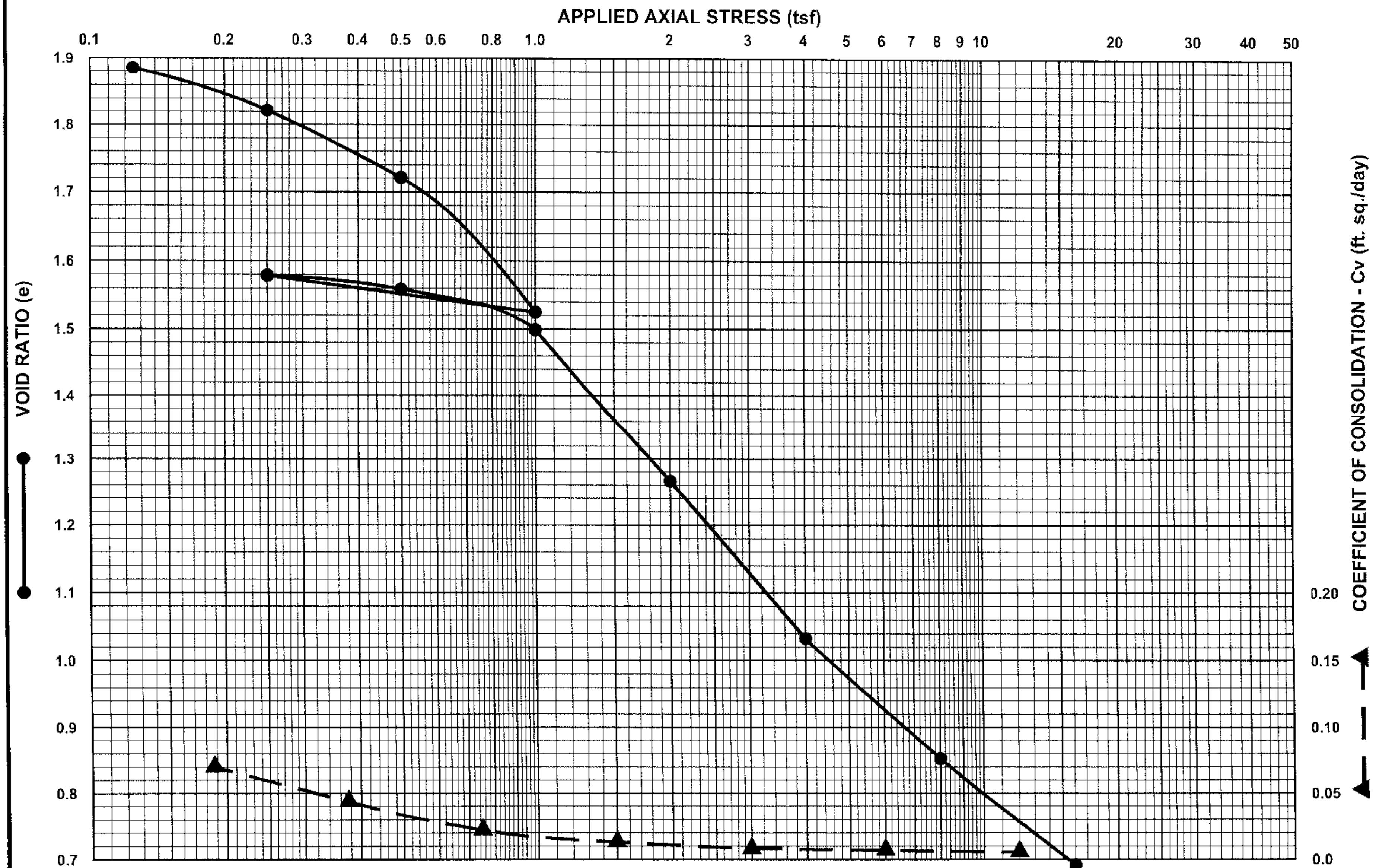
FILE NO.: 06-1046

STE
Soil Testing Engineers, Inc.

CLASSIFICATION DATA

INITIAL MOISTURE CONTENT (%) = 56.0 LL = 64
INITIAL DRY DENSITY (lbs./cu.ft.) = 65.8 PL = 28
FINAL MOISTURE CONTENT (%) = 31.7 PI = 36
Eo = 1.465 Gs = 2.6 Assumed

FIGURE NO.:



CONSOLIDATION TEST

SAMPLE IDENTIFICATION

BORING NO.: L-2
DEPTH (feet): 38-40
MATERIAL: Gray CLAY w/sand laminations
FILE NO.: 06-1046

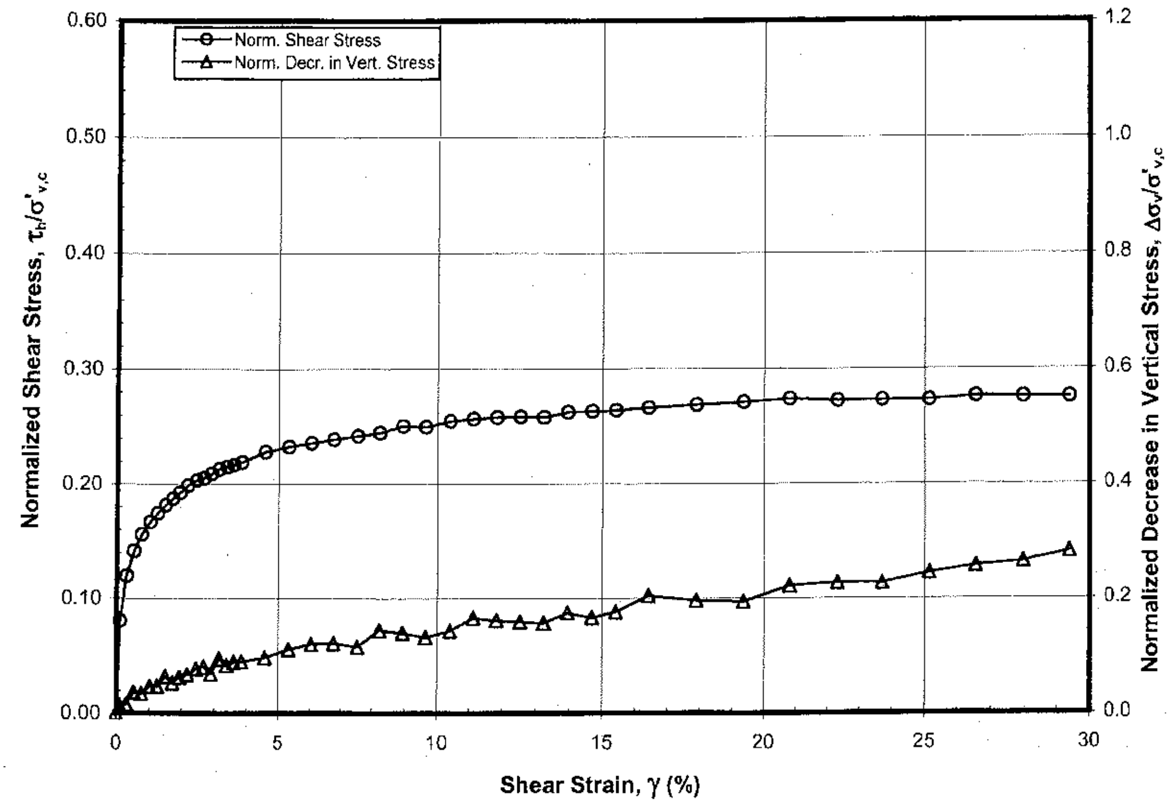
STE
Soil Testing Engineers, Inc.

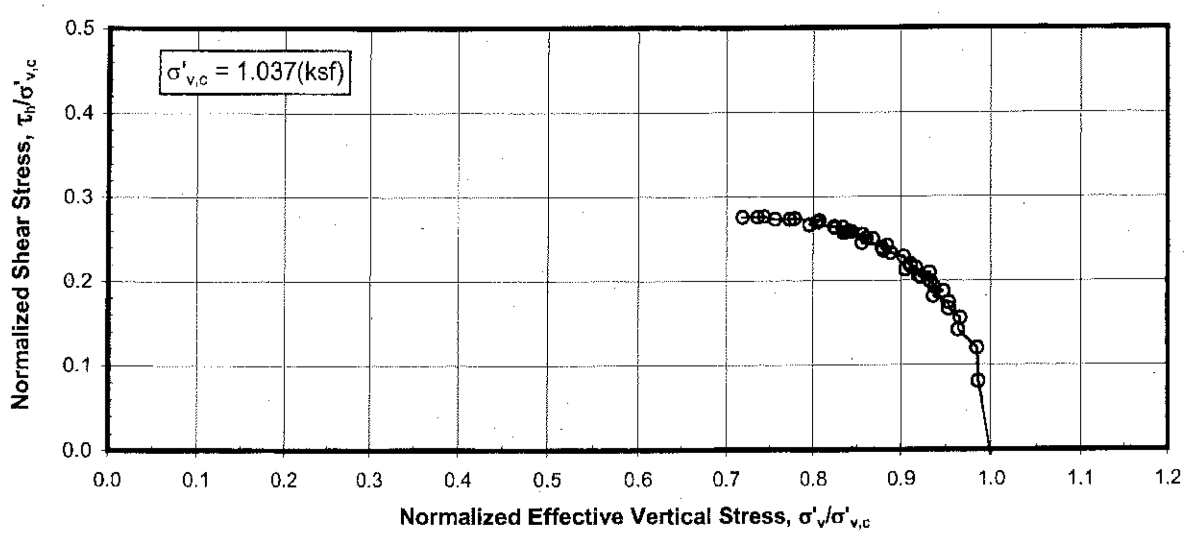
CLASSIFICATION DATA

INITIAL MOISTURE CONTENT (%) = 71.1 LL = 81
INITIAL DRY DENSITY (lbs./cu.ft.) = 55.6 PL = 25
FINAL MOISTURE CONTENT (%) = 31.8 PI = 56
Eo = 1.918 Gs = 2.6 Assumed

FIGURE NO.:

DRAFT





STATIC DSS TEST

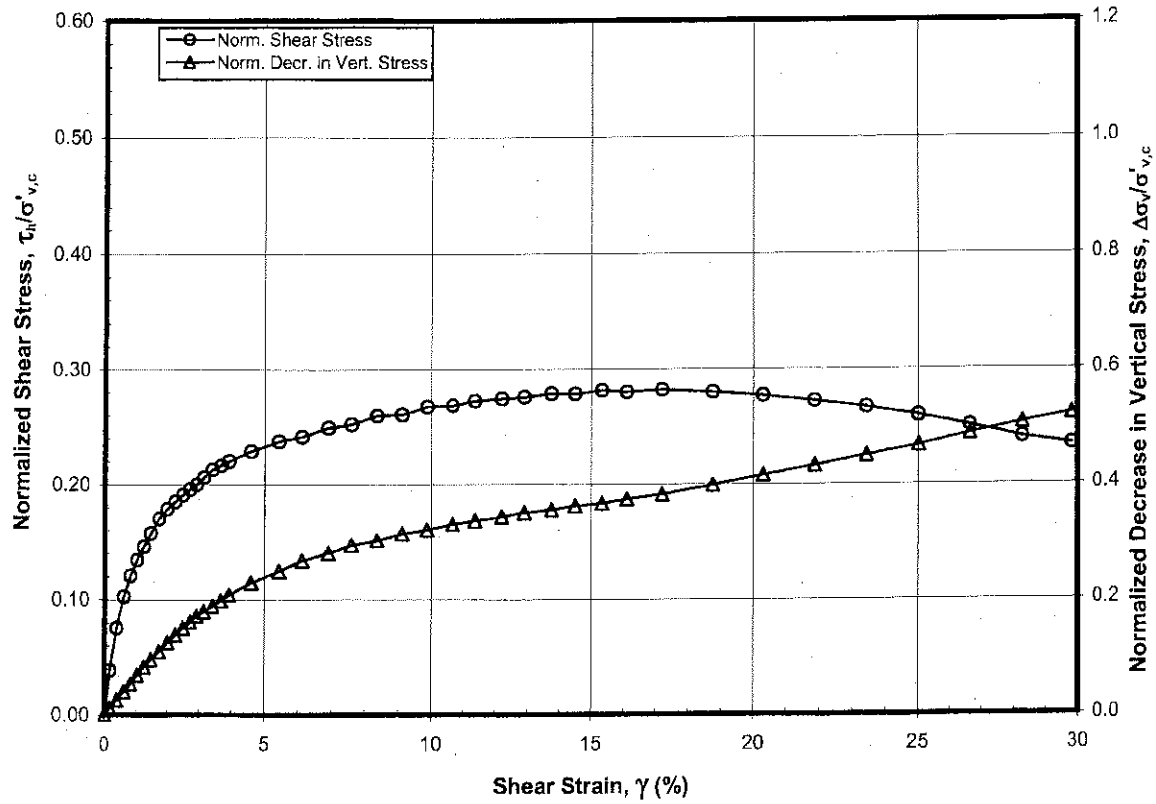
K_o Consolidation - OCR = 1

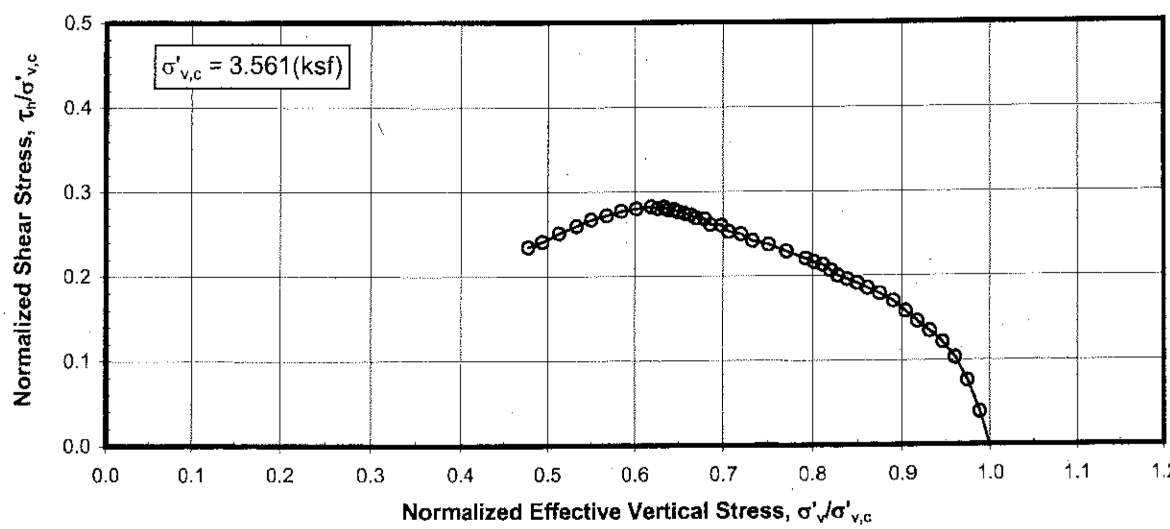
Sample: 14b - Depth: 13.60 ft

Boring B-2

Reviewed By:______

DRAFT





STATIC DSS TEST

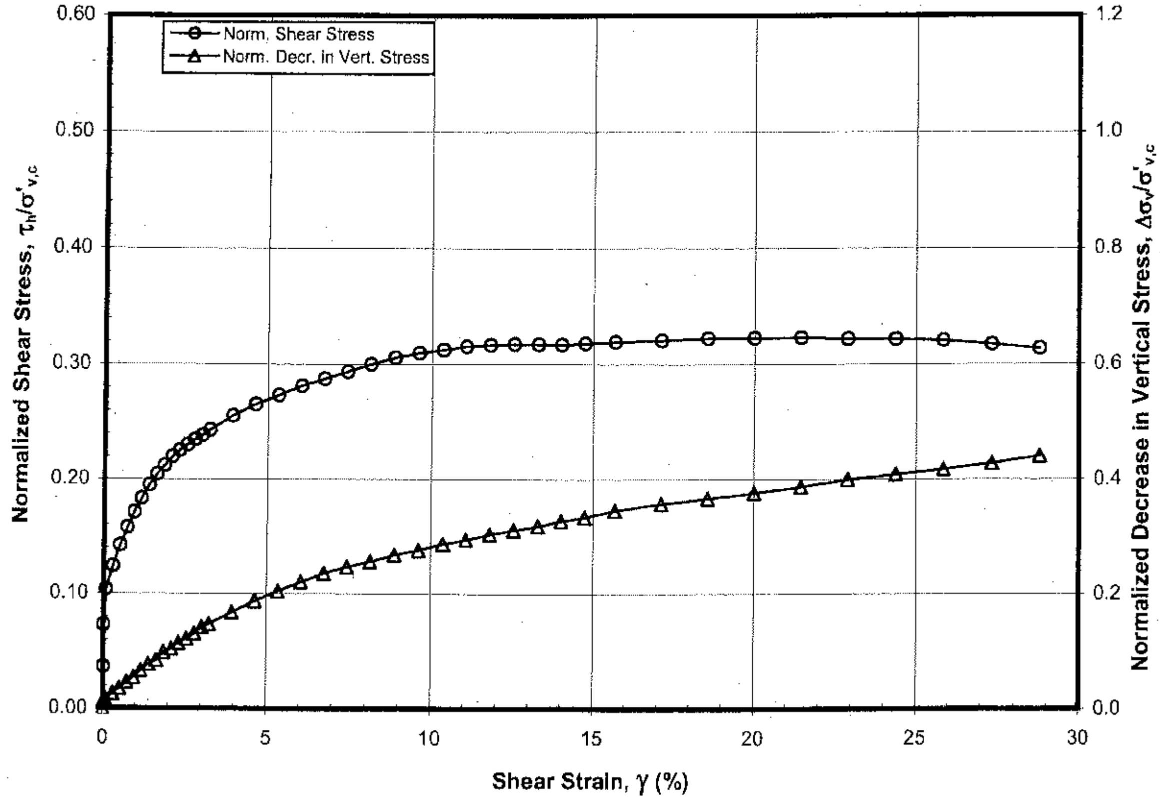
K_o Consolidation - OCR = 1

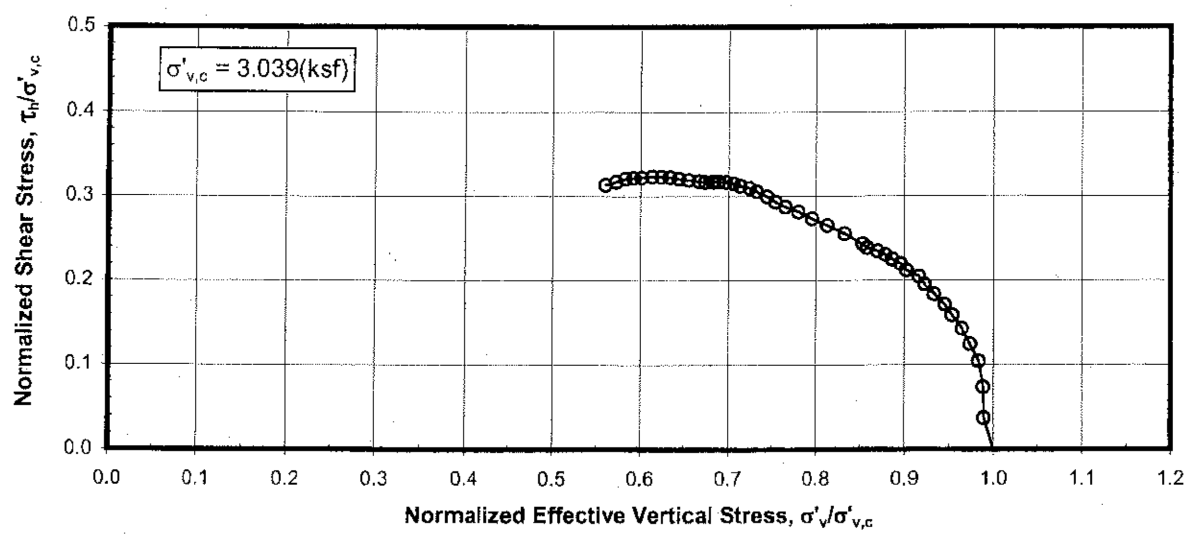
Sample: 28b - Depth: 27.55 ft

Boring B-2

Reviewed By:______

DRAFT





STATIC DSS TEST

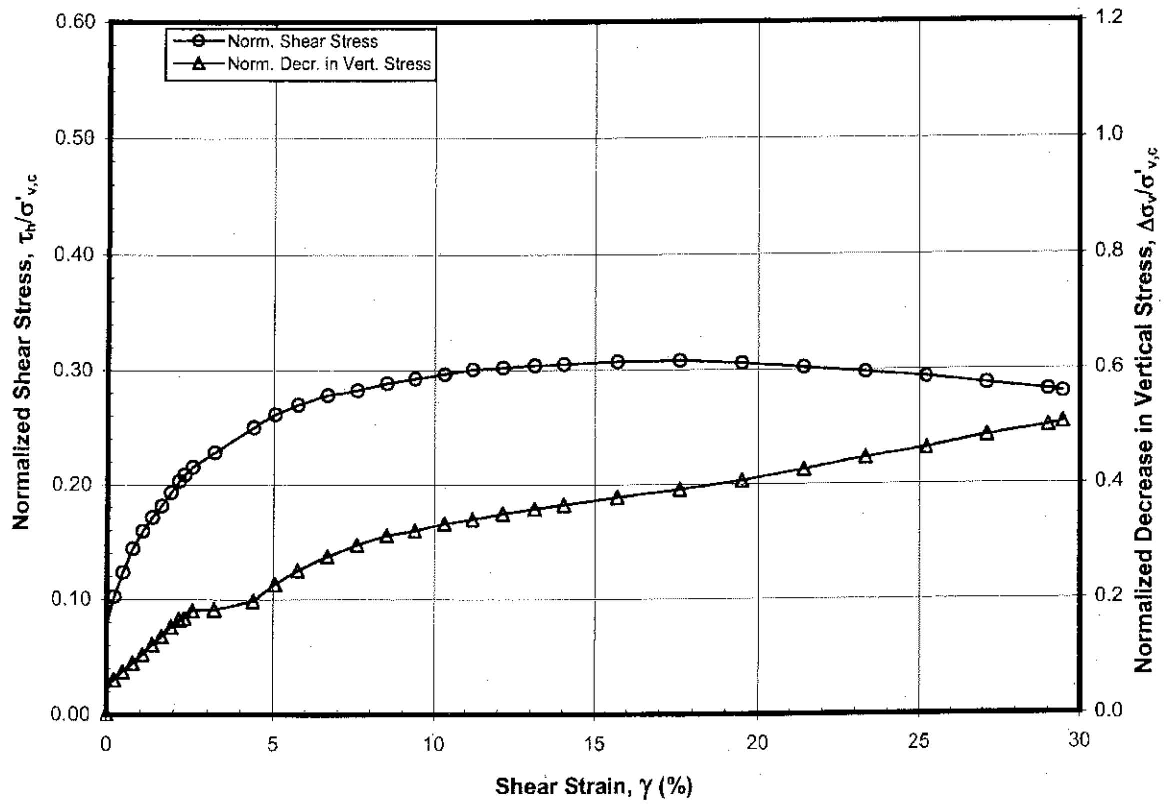
K_o Consolidation - OCR = 1

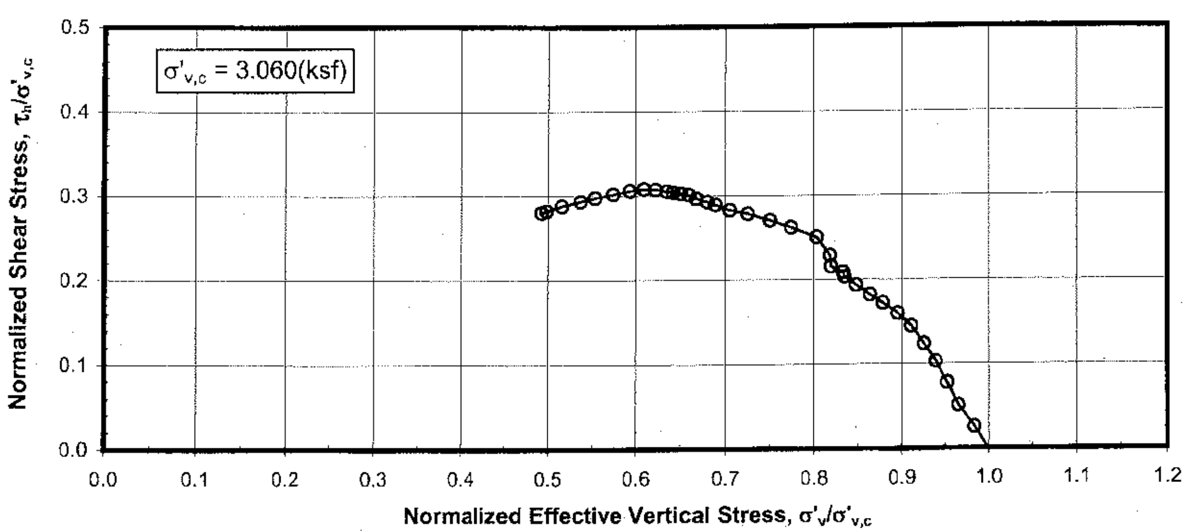
Sample: 48b - Depth: 47.50 ft

Boring B-2

Reviewed By:_____

DRAFT





STATIC DSS TEST

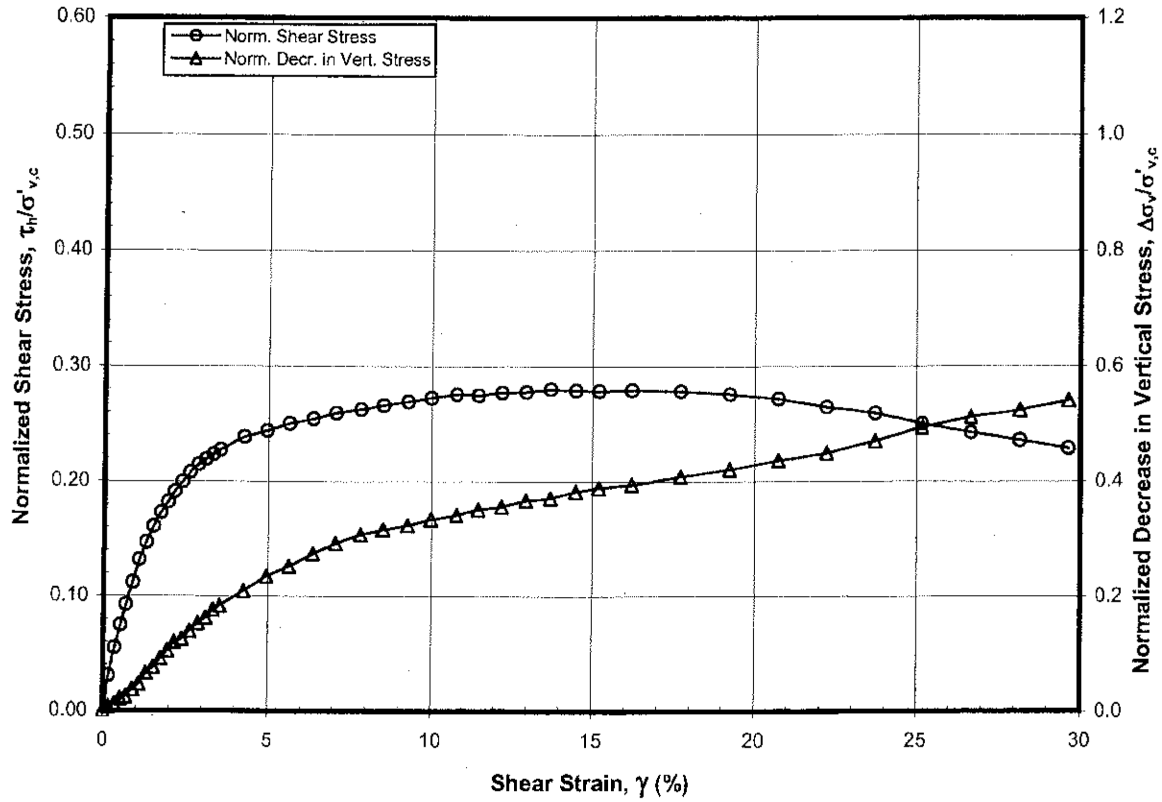
K_o Consolidation - OCR = 1

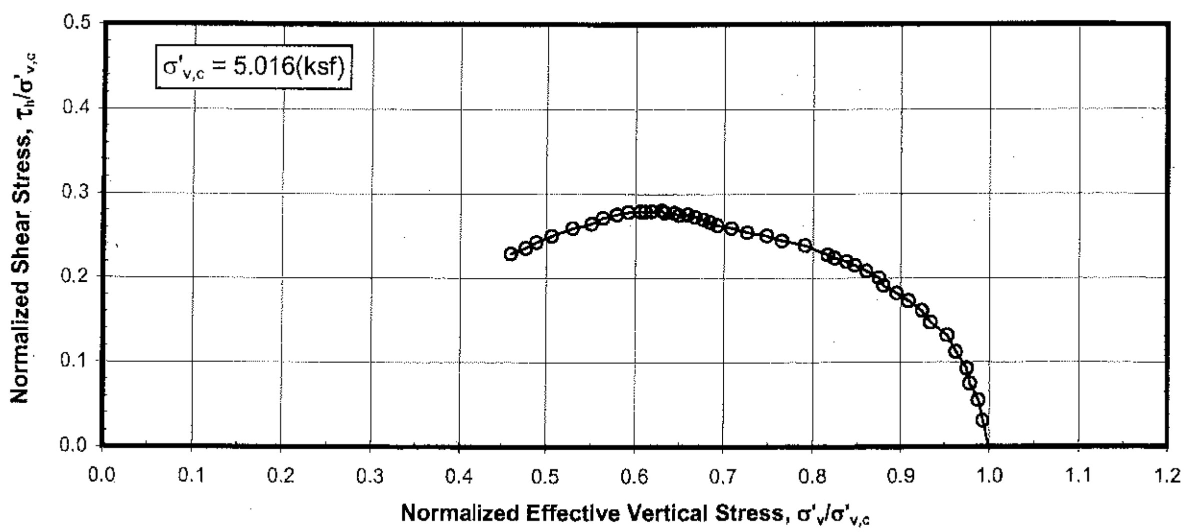
Sample: 14b - Depth: 13.30 ft

Boring B-3

Reviewed By:______

DRAFT





STATIC DSS TEST

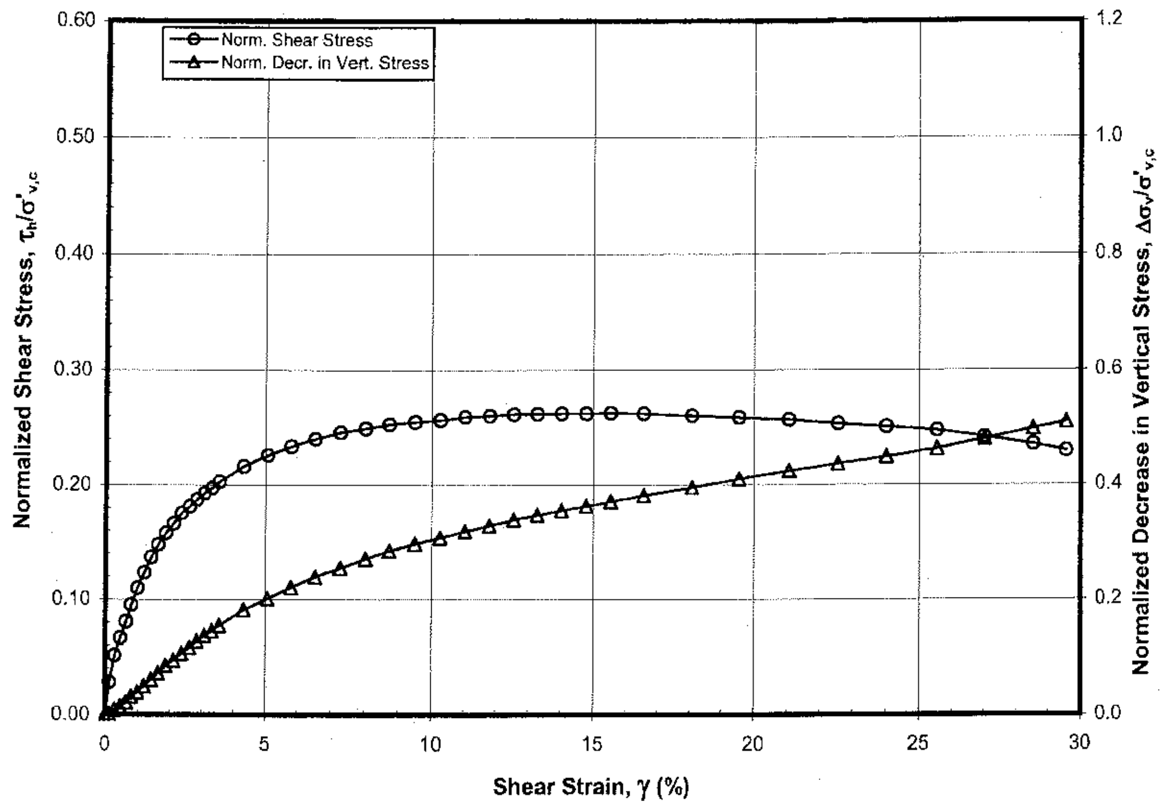
K_o Consolidation - OCR = 1

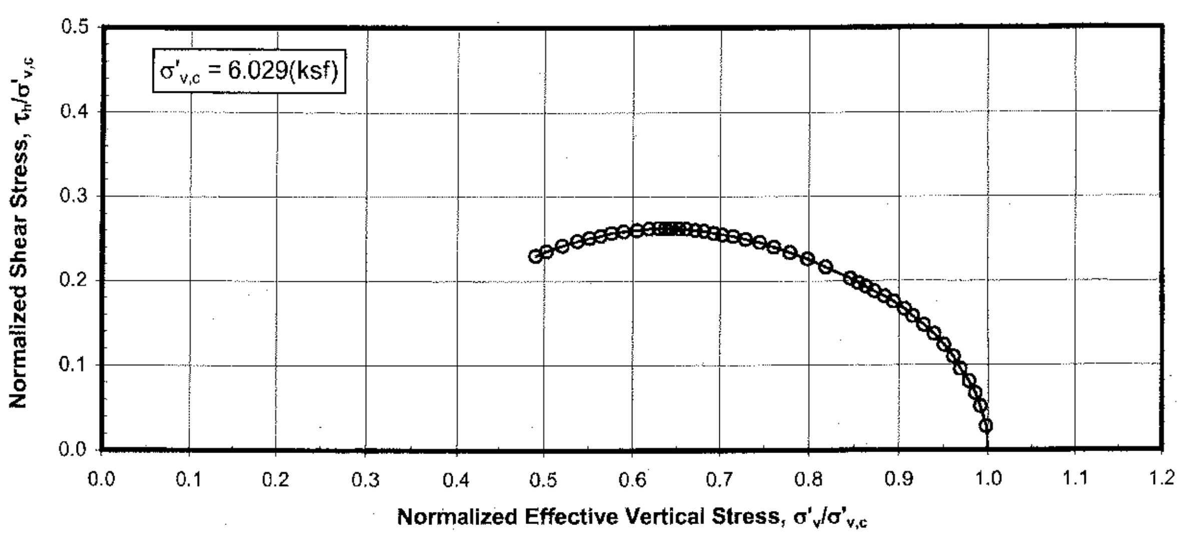
Sample: 22b - Depth: 21.65 ft

Boring B-3

Reviewed By:______

DRAFT





STATIC DSS TEST

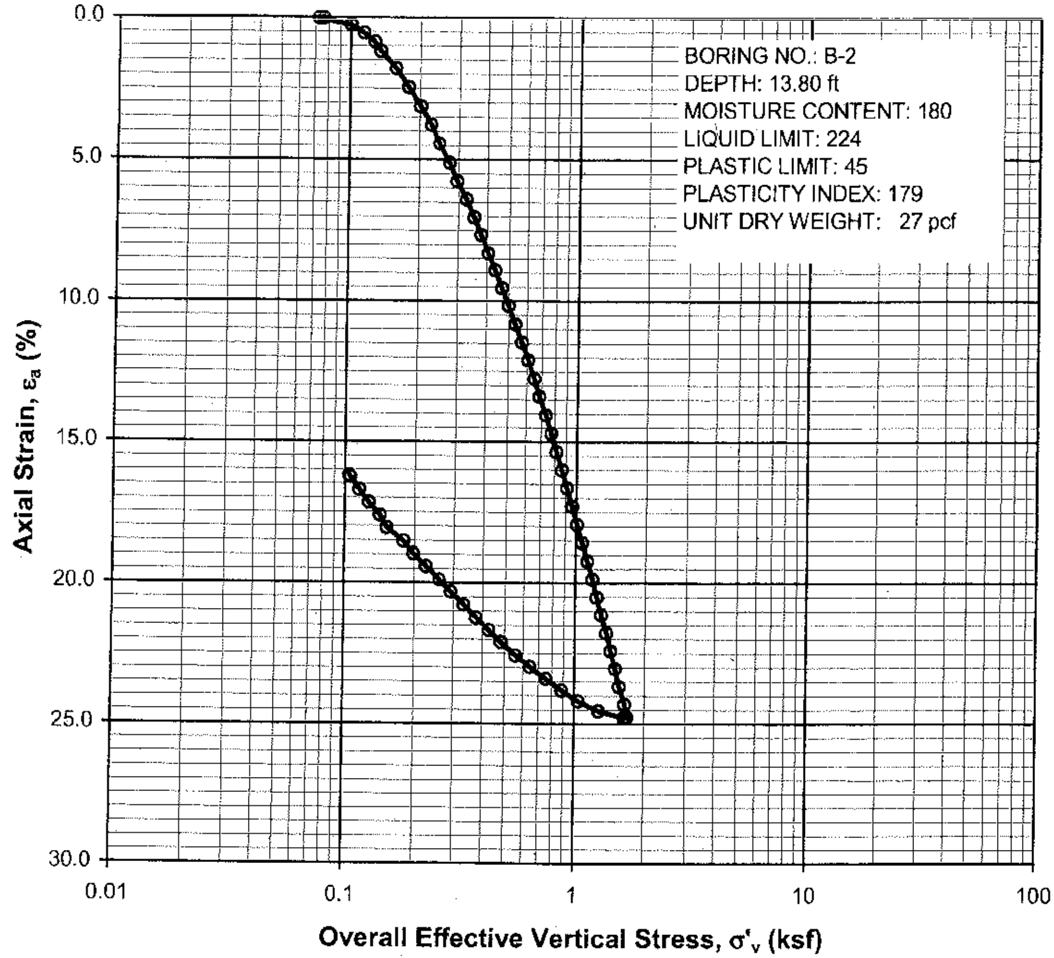
K_o Consolidation - OCR = 1

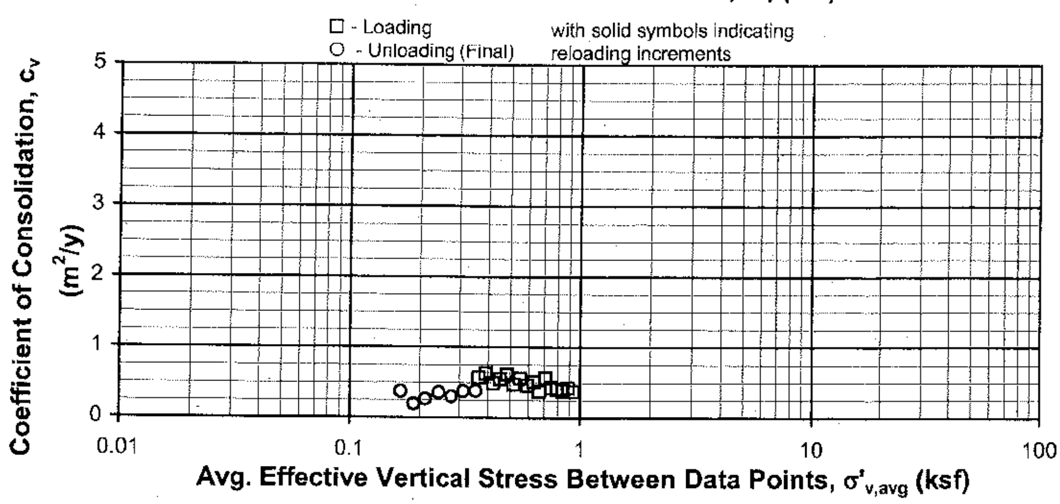
Sample: 48b - Depth: 47.55 ft

Boring B-3

Reviewed By:_____

DRAFT





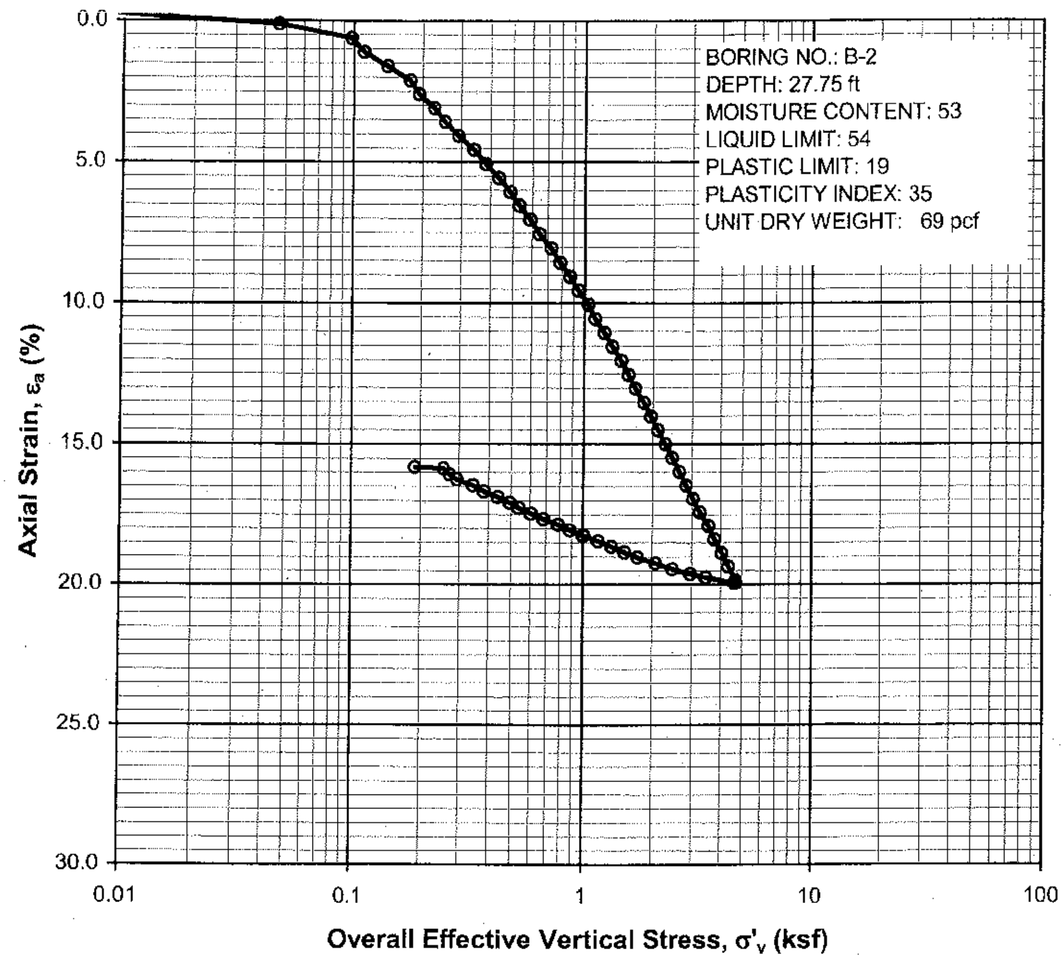
1-D CONSOLIDATION TEST: CRS

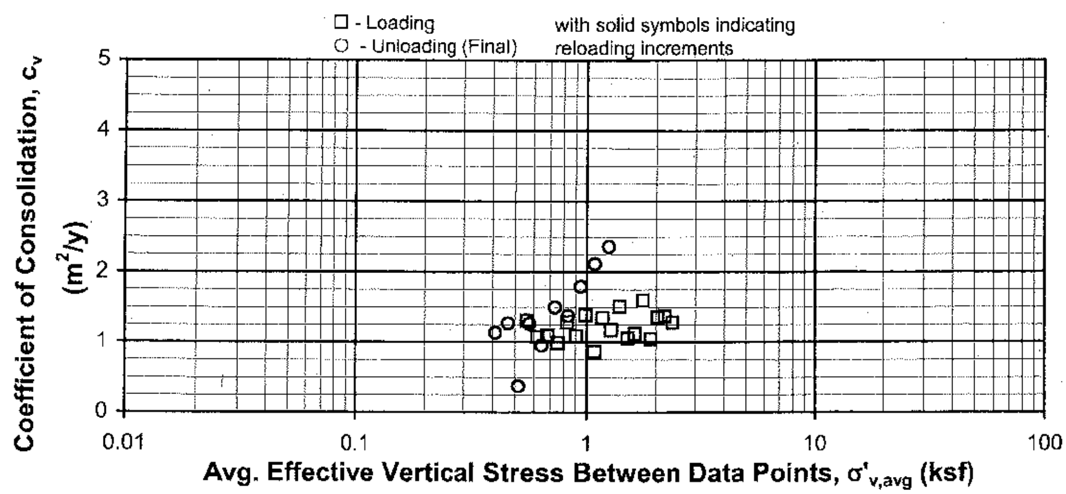
Sample No. 14a - Depth 13.80 ft

Boring B-2

Reviewed By: ______

DRAFT





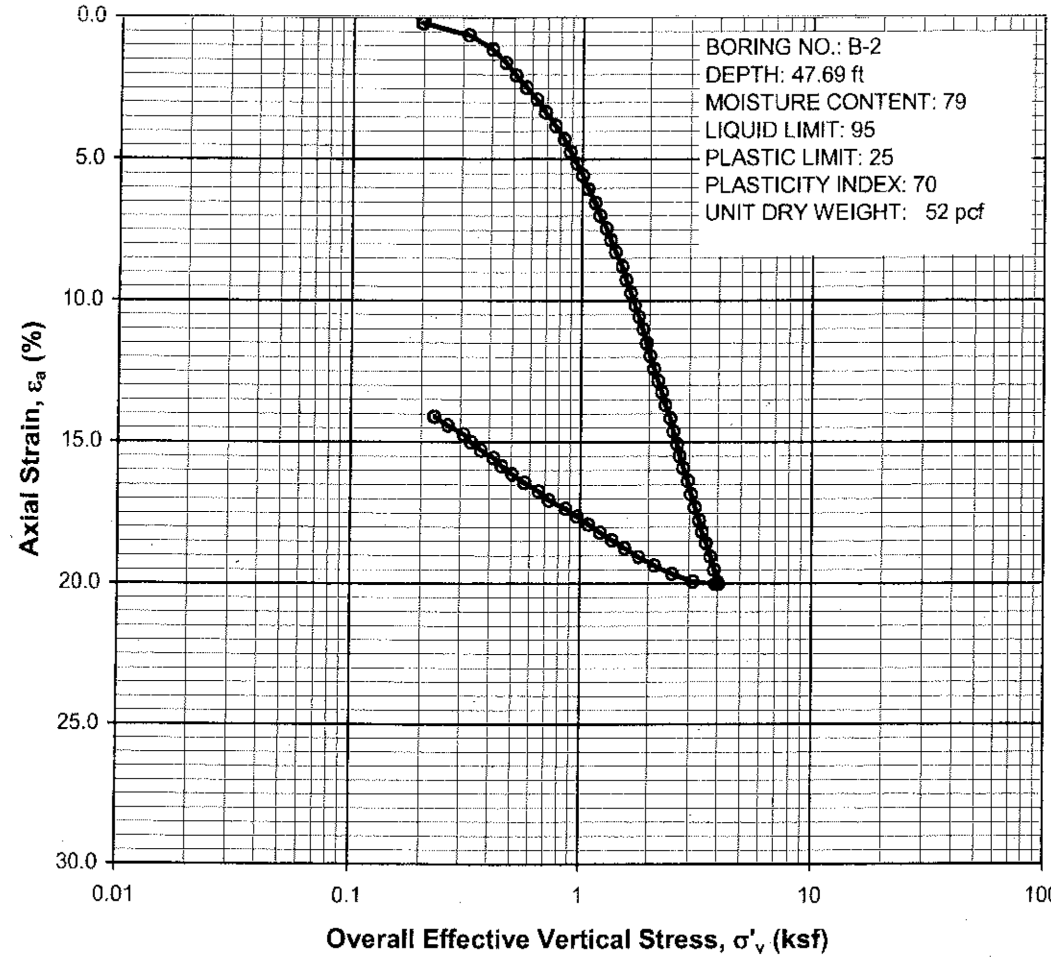
1-D CONSOLIDATION TEST: CRS

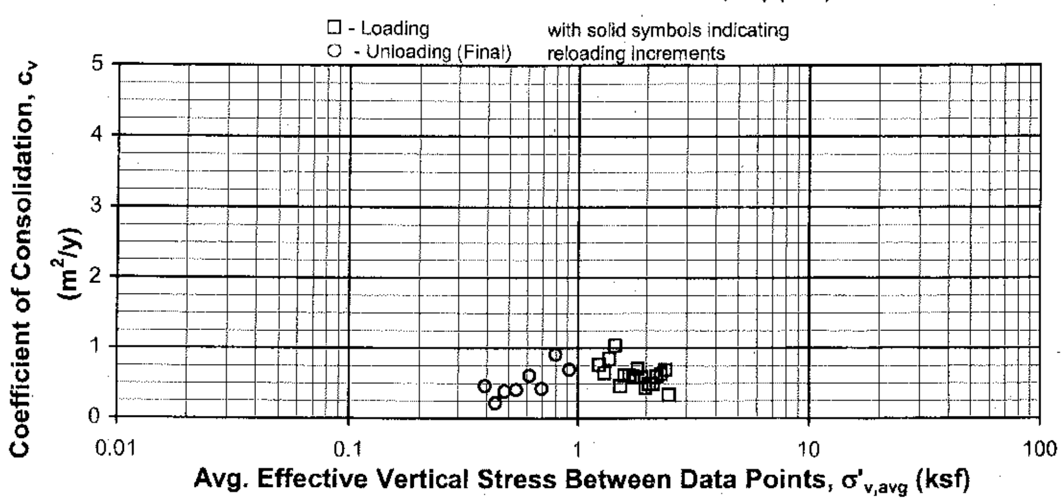
Sample No. 28a - Depth 27.75 ft

Boring B-2

Reviewed By: _______

DRAFT





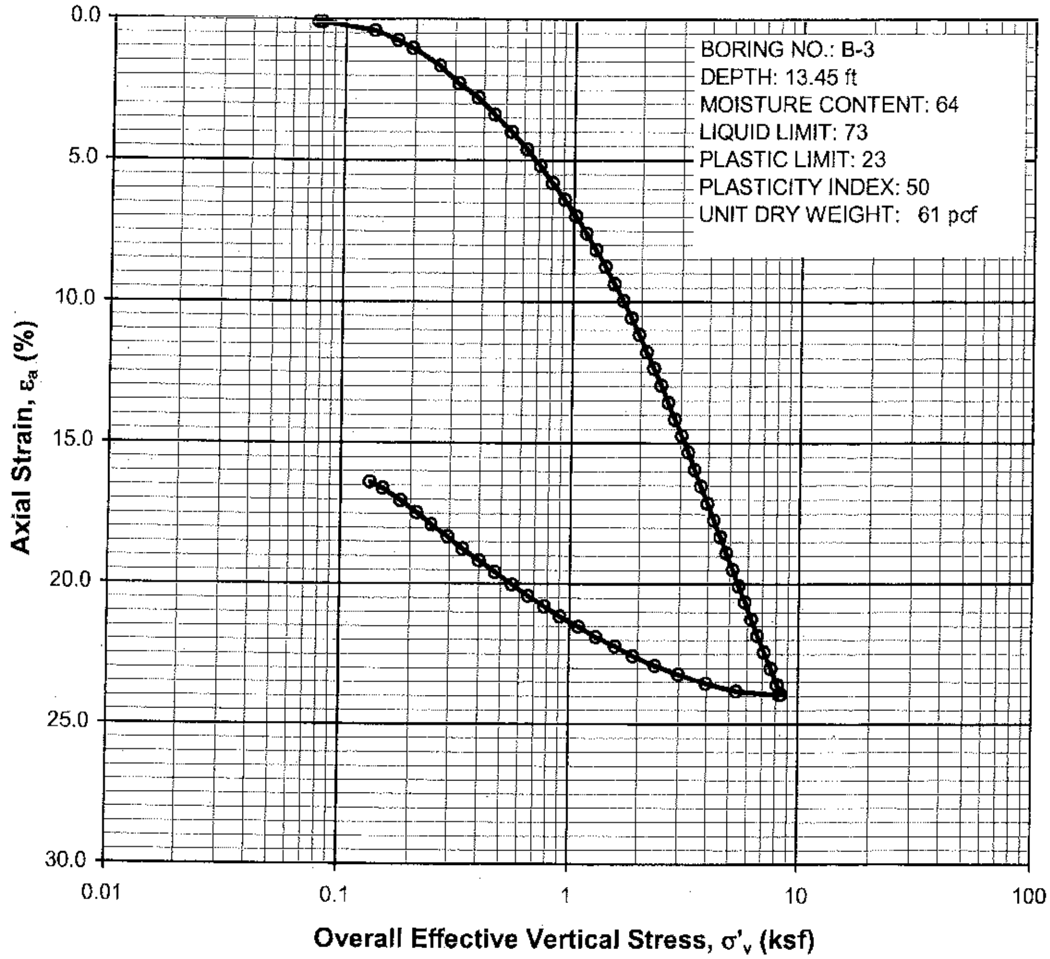
1-D CONSOLIDATION TEST: CRS

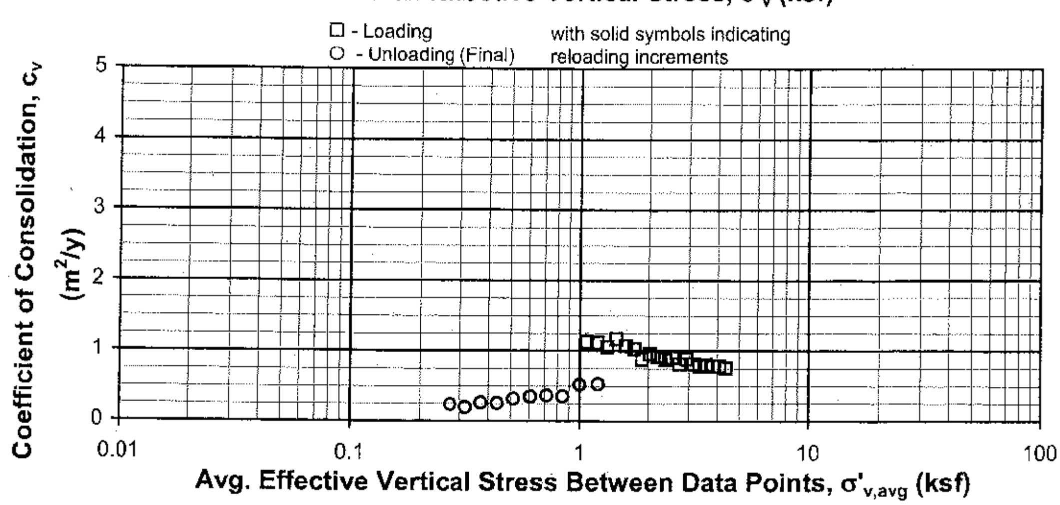
Sample No. 48a - Depth 47.69 ft

Boring B-2

Reviewed By: _______

DRAFT





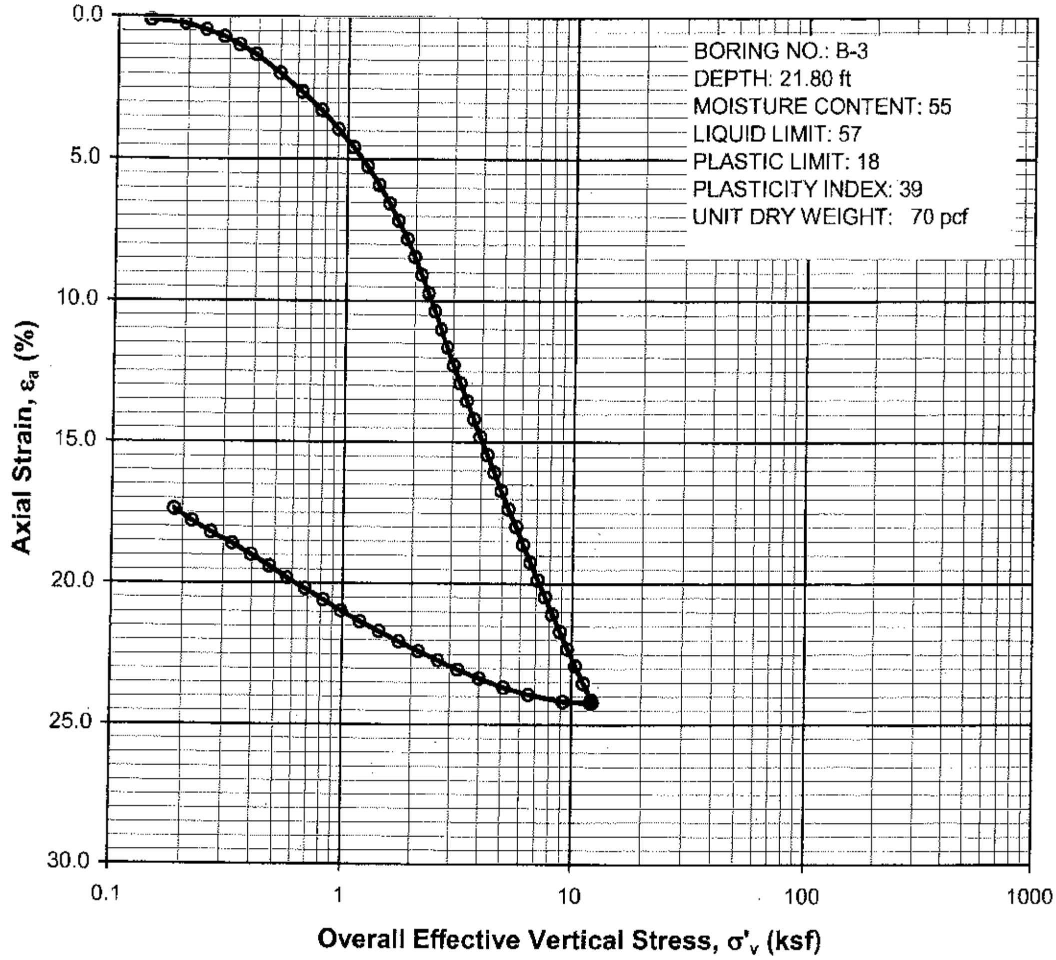
1-D CONSOLIDATION TEST: CRS

Sample No. 14a - Depth 13.45 ft

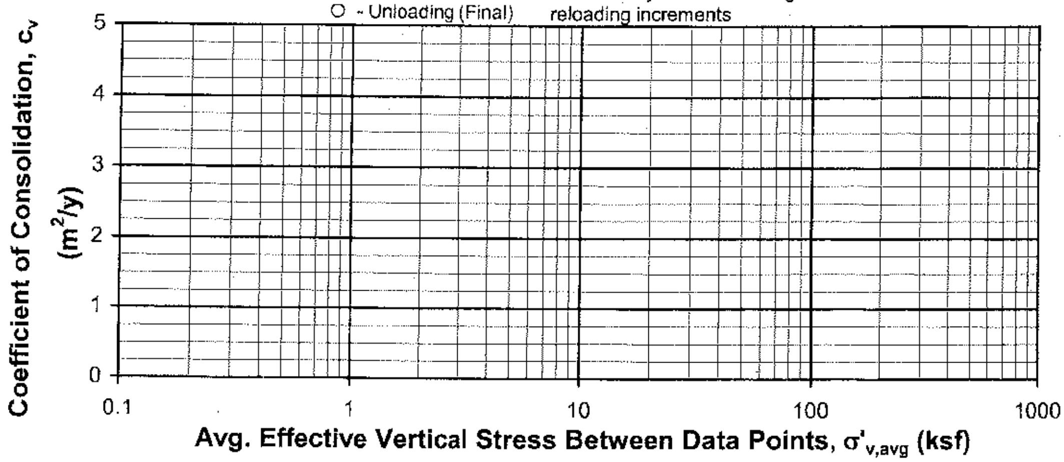
Boring B-3

Reviewed By: ______

DRAFT



□ - Loading
○ - Unloading (Final)
with solid symbols indicating reloading increments



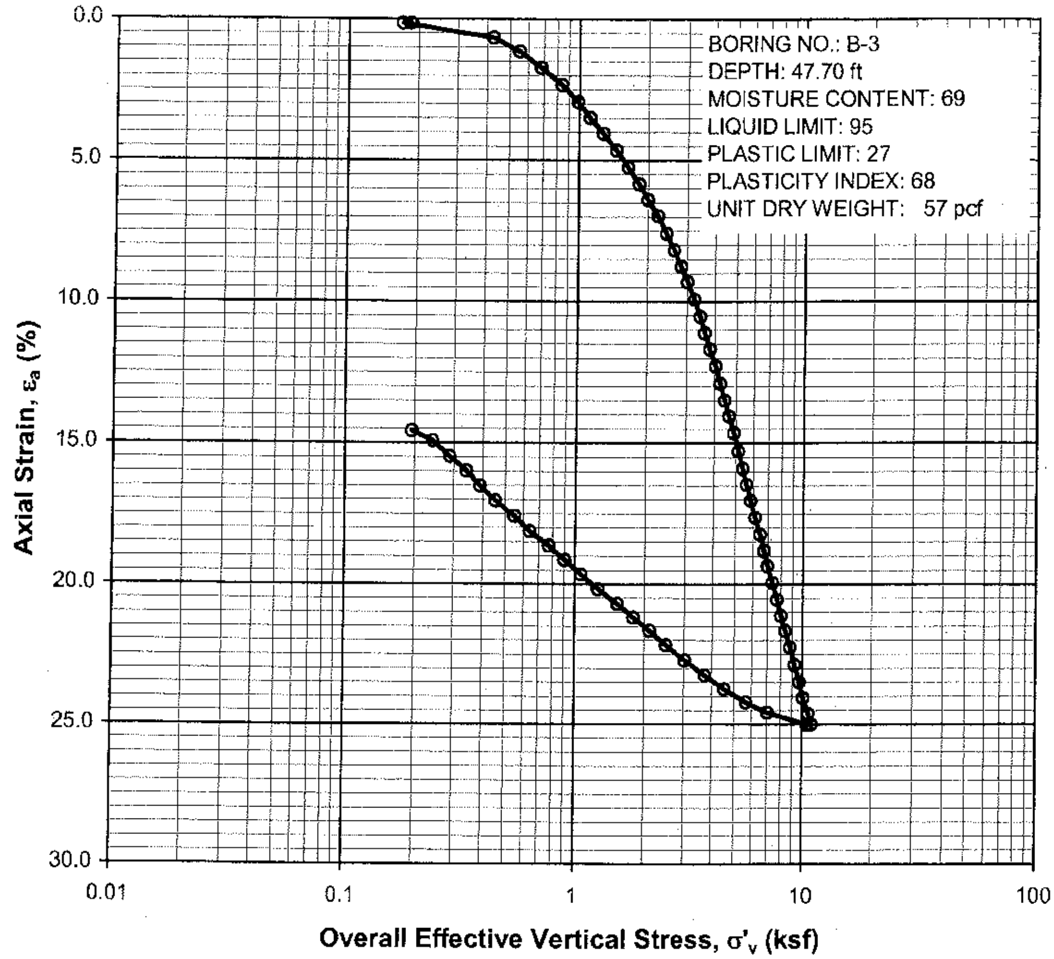
1-D CONSOLIDATION TEST: CRS

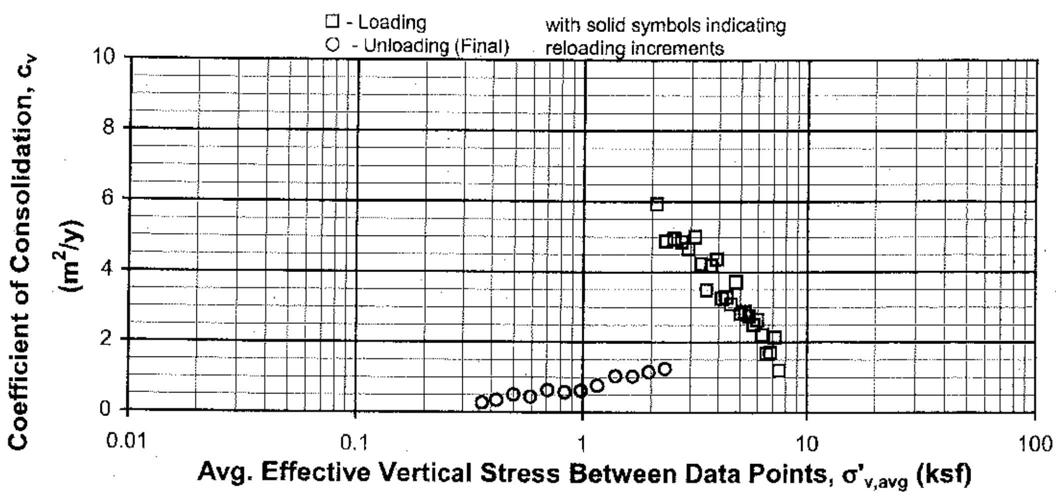
Sample No. 22a - Depth 21.80 ft

Boring B-3

Reviewed By: _______

DRAFT





1-D CONSOLIDATION TEST: CRS

Sample No. 48a - Depth 47.70 ft

Boring B-3

Reviewed By: _______

APPENDIX B

Soil Testing Engineers, Inc.

APPENDIX B

CPT-FIELD PROCEDURES

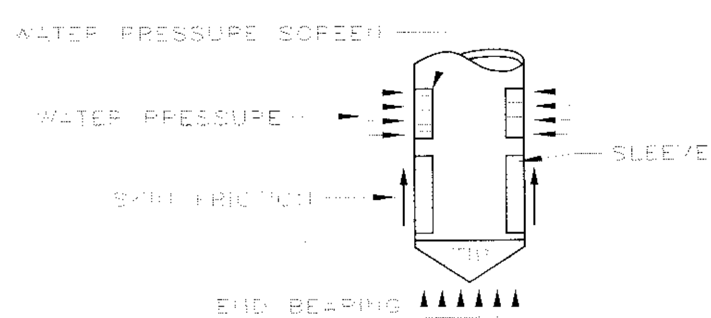
The following paragraphs describe the field and laboratory procedures used for this investigation for the cone penetrometer soundings (CPT). CPT logs are included with this appendix. The logs included with this appendix are from both STE's activities and the soundings made for the U.S. EPA by others.

B.1 FIELD EXPLORATION

One (1) CPT sounding was made by STE to a depth of 70 feet below ground surface in order to supplement the undisturbed soil borings. Due to its ability to continuously measure in-situ shear strength of the underlying subsoils, the CPT soundings provide invaluable data with regards to analyzing soft cohesive soils.

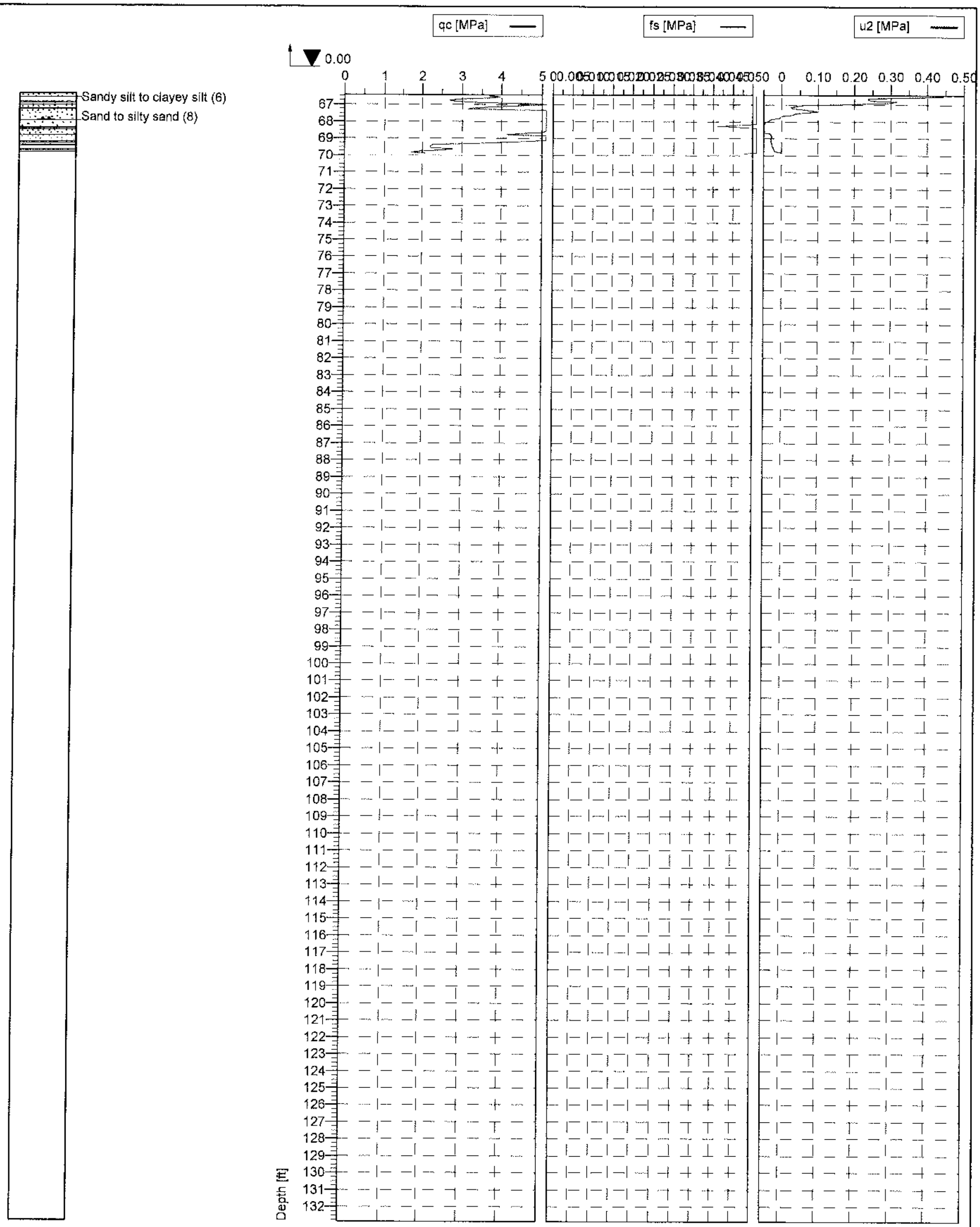
STE's soundings were made on 10 May 2006. The soundings made for the U.S. EPA were performed on 17 May 2006. The approximate locations of the soundings are shown on the Boring Plan, Figure 1.

For the CPT equipment, the sensing tip is pushed continuously into the soil by a hydraulic ram. Data is transmitted from the CPT sensor to the operator as it occurs for real time evaluation. The force is transmitted from the rig through small diameter rods. As illustrated in the sketch below, the tip has three sensing units. It measures simultaneously the resistance at the end of the tip (end-bearing), the resistance along the vertical sides of the sleeve above the tip (skin-friction), and the groundwater pressure just above the sleeve.



SKETCH - CPT TIP

The absolute values of the tip and sleeve resistance can be related to the soil shear strength. This ratio (sleeve/tip) depends on the ratio of soil cohesion (c) to its friction [Tan(φ)]. A high sleeve/tip ratio indicates a clayey soil, while a low ratio indicates a sandy soil. The soil stratigraphy shown on the CPT plots is identified using Campanella and Robertson's Simplified Soil Behavior Chart.

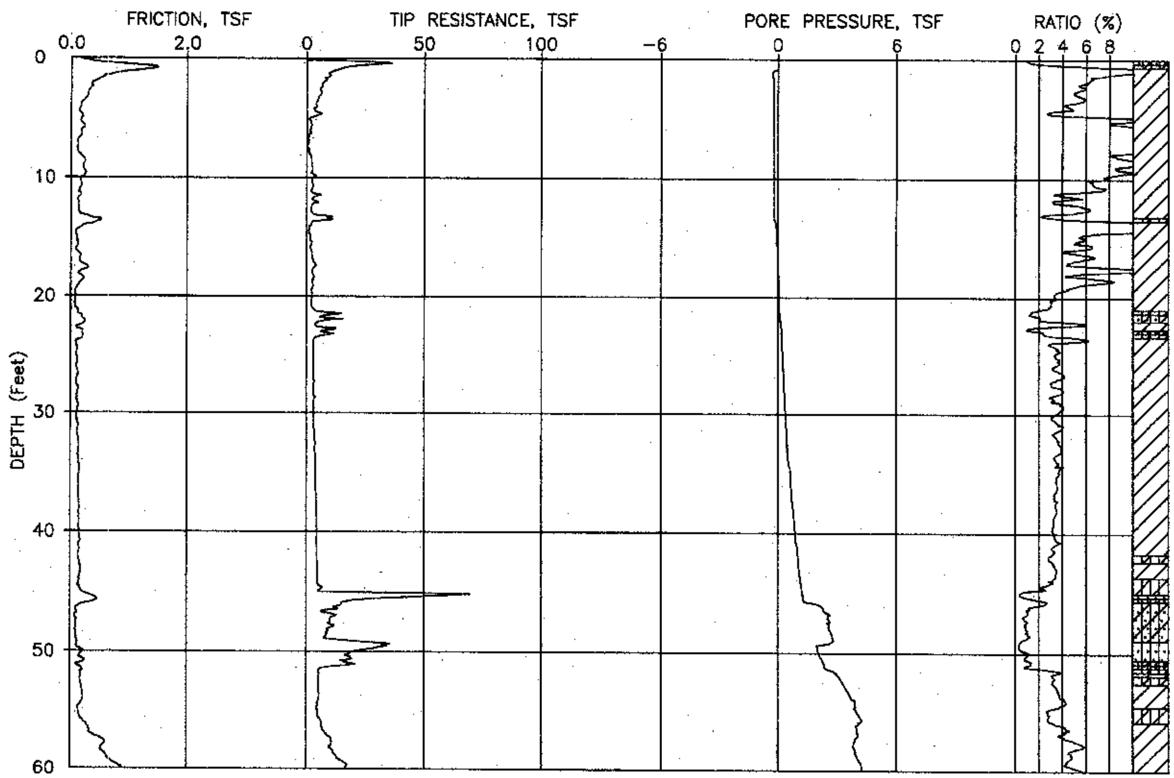


U2

Cone No: 0
Tip area [cm2]: 10
Sleeve area [cm2]: 150

Test no: CPT-1	Position: X: 0.00 m, Y: 0.00 m	Ground level: 0.00	
Client:		Date: 5/10/2006	Scale: 1 : 100
Project:		Page: 2/2	Fig:
		File: Gentilly LF-CPT-1 m.cpt	

MEASURED CPT DATA



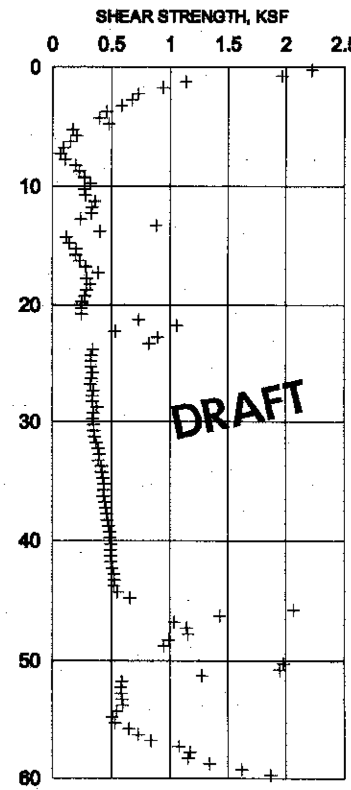
CPT NUMBER: B-1

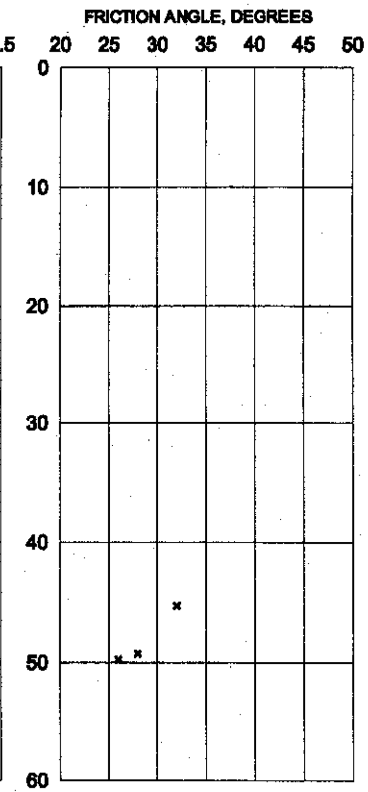
CONE NUMBER: F7.5CKEW966

DATE: 05-17-2006

PLATE: 1 OF 2

CORRELATED SOIL PROPERTIES

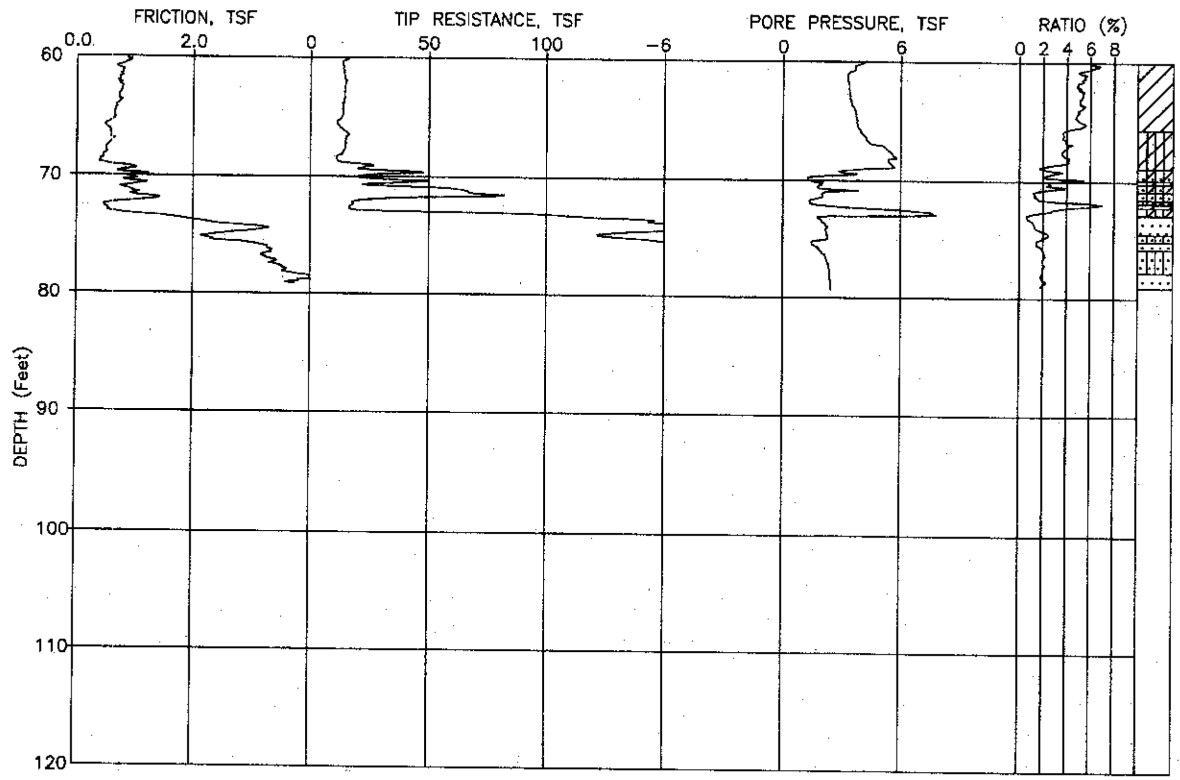




NOTE: THE CORRELATED SOIL PROPERTIES (FRICTION ANGLE) ARE BASED ON MODIFIED ROBERTSON & CAMPANELLA METHOD.

CONE PENETROMETER TEST RESULTS - CPT B1
GENTILLY LANDFILL
NEW ORLEANS, LOUISIANA

MEASURED CPT DATA



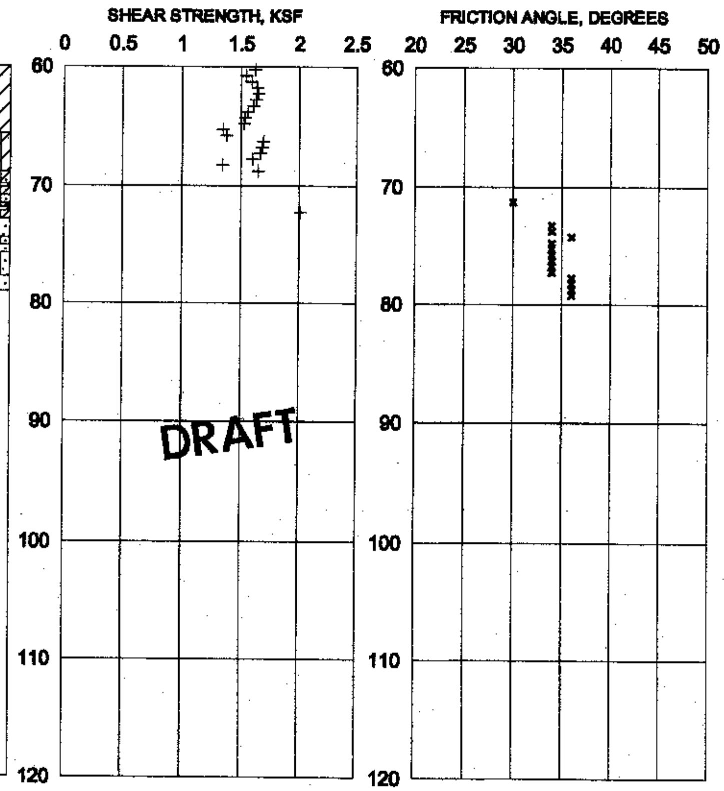
CPT NUMBER: B-1

CONE NUMBER: F7.5CKEW966

DATE: 05-17-2006

PLATE: 2 OF 2

CORRELATED SOIL PROPERTIES

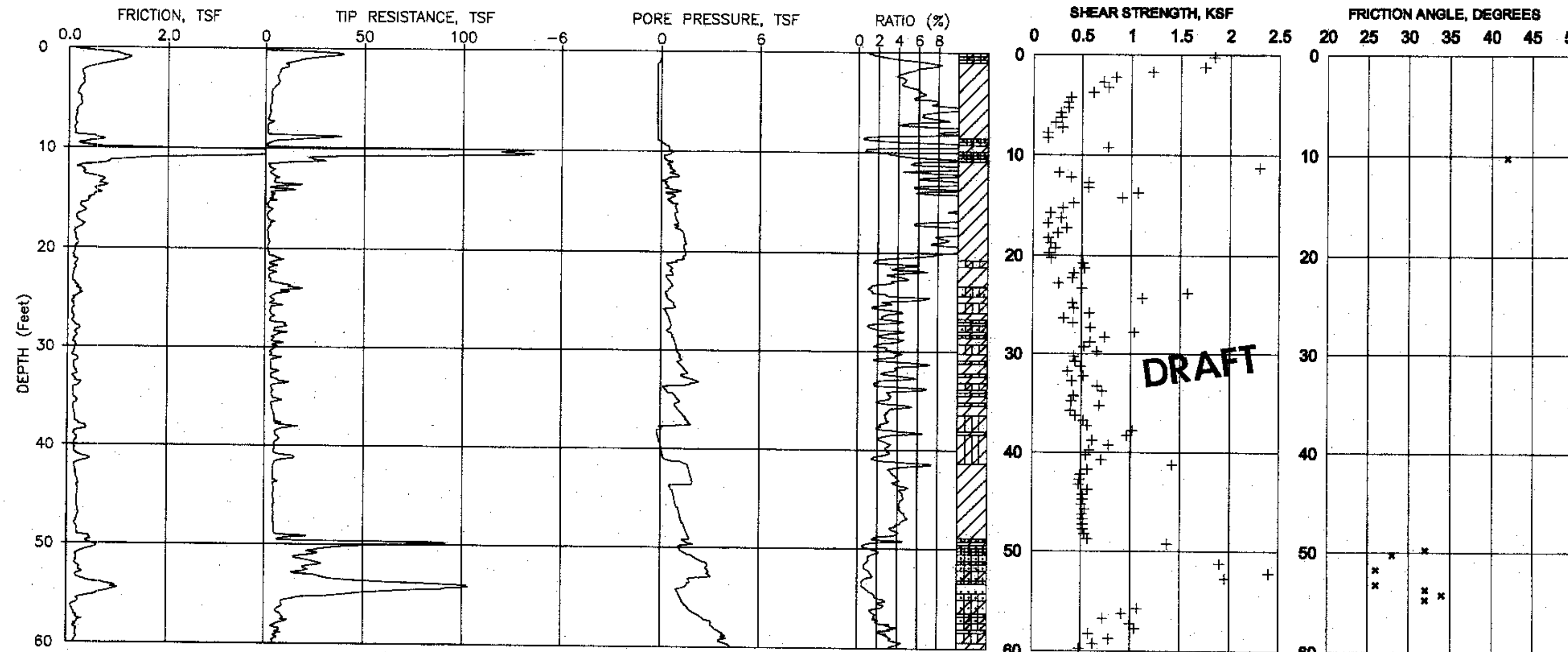


NOTE: THE CORRELATED SOIL PROPERTIES (FRICTION ANGLE) ARE BASED ON MODIFIED ROBERTSON & CAMPANELLA METHOD.

CONE PENETROMETER TEST RESULTS - CPT B1
GENTILLY LANDFILL
NEW ORLEANS, LOUISIANA

MEASURED CPT DATA

CORRELATED SOIL PROPERTIES



CPT NUMBER: B-3

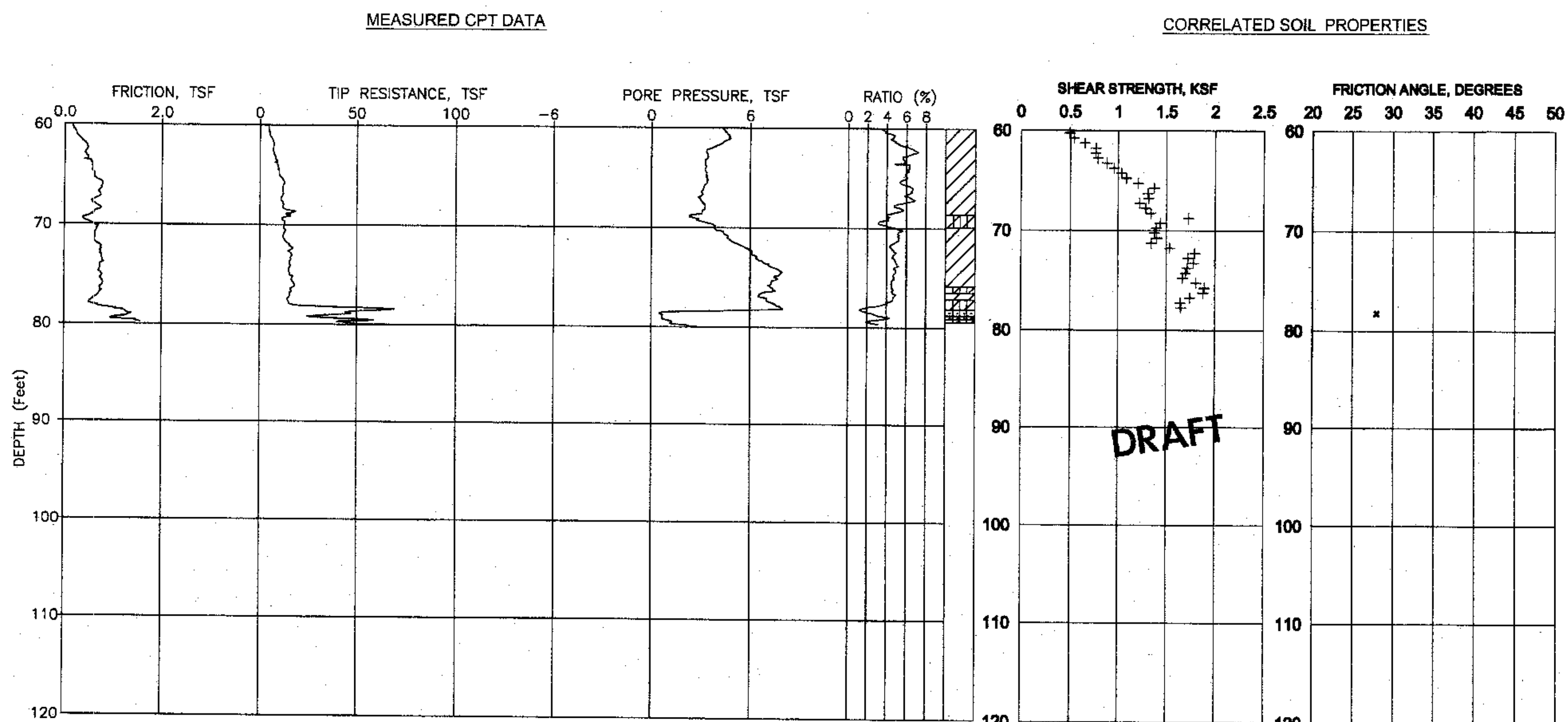
CONE NUMBER: F7.5CKEW966

DATE: 05-17-2006

PLATE: 1 OF 2

NOTE: THE CORRELATED SOIL PROPERTIES (FRICTION ANGLE) ARE BASED ON MODIFIED ROBERTSON & CAMPANELLA METHOD.

CONE PENETROMETER TEST RESULTS - CPT B3
GENTILLY LANDFILL
NEW ORLEANS, LOUISIANA



CPT NUMBER: B-3

CONE NUMBER: F7.5CKEW966

DATE: 05-17-2006

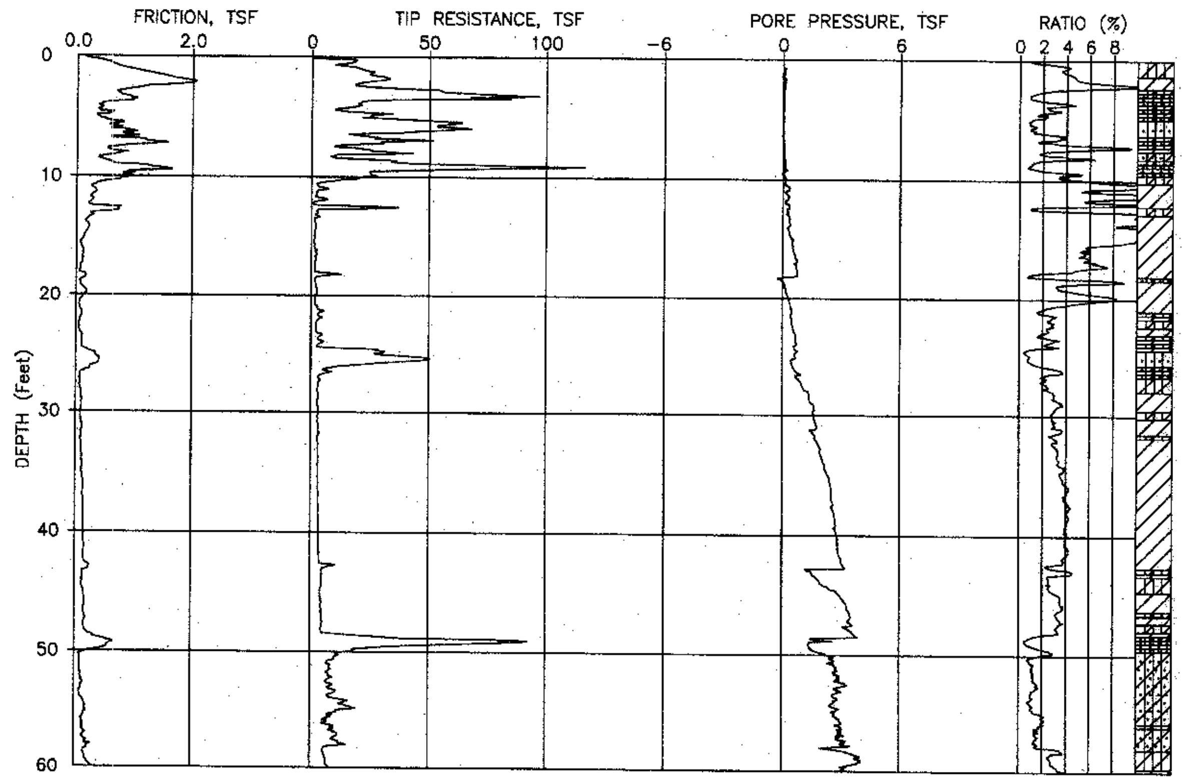
PLATE: 2 OF 2

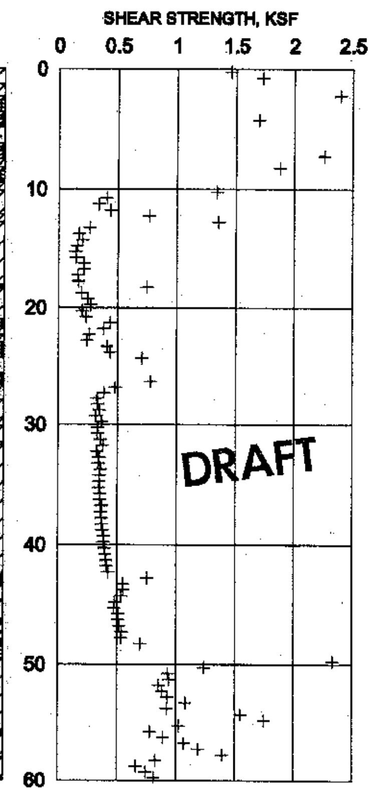
NOTE: THE CORRELATED SOIL PROPERTIES (FRICTION ANGLE) ARE BASED ON MODIFIED ROBERTSON & CAMPANELLA METHOD.

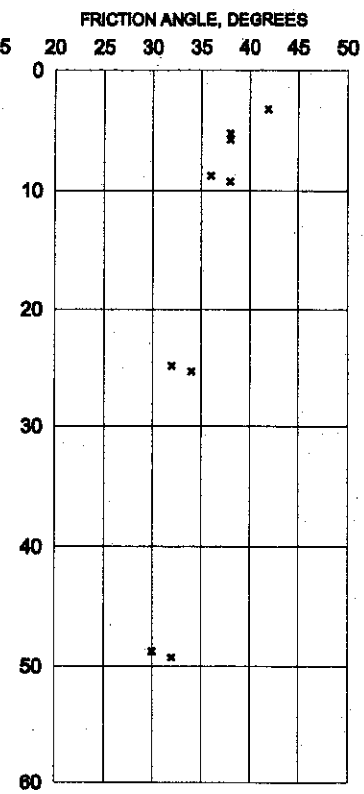
CONE PENETROMETER TEST RESULTS - CPT B3
GENTILLY LANDFILL
NEW ORLEANS, LOUISIANA

MEASURED CPT DATA

CORRELATED SOIL PROPERTIES







CPT NUMBER: CB-3

CONE NUMBER: F7.5CKEW966

DATE: 05-17-2006

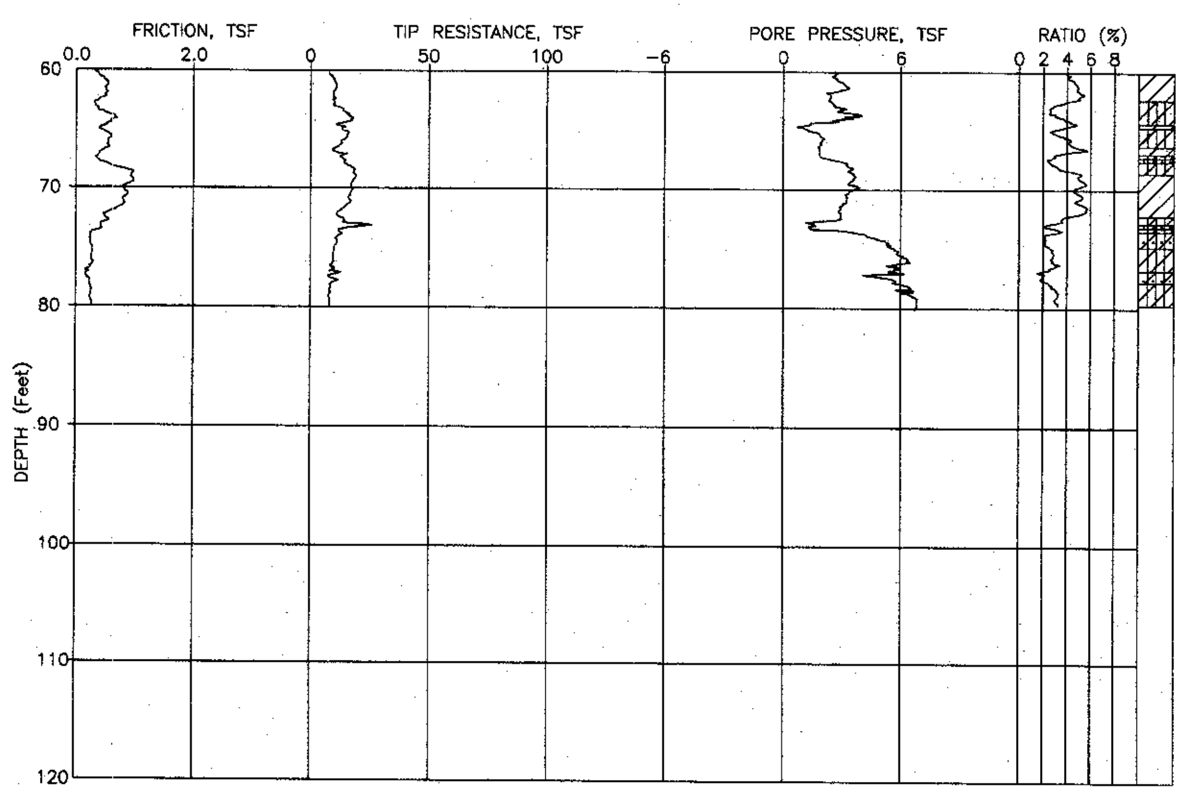
PLATE: 1 OF 2

NOTE: THE CORRELATED SOIL PROPERTIES (FRICTION ANGLE) ARE BASED ON MODIFIED ROBERTSON & CAMPANELLA METHOD.

CONE PENETROMETER TEST RESULTS - CPT CB3
GENTILLY LANDFILL
NEW ORLEANS, LOUISIANA

Report No. 5506-4022

MEASURED CPT DATA



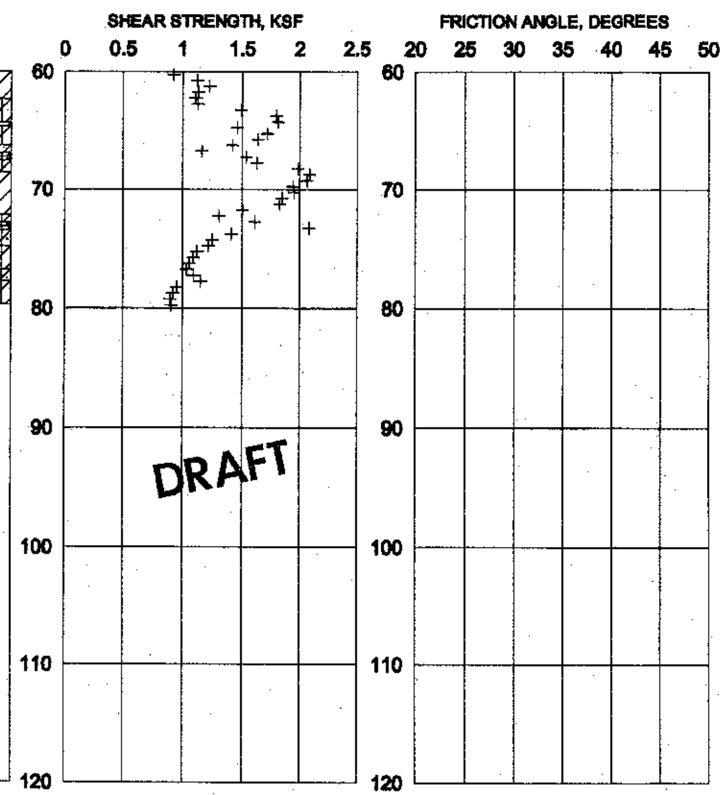
CPT NUMBER: CB-3

CONE NUMBER: F7.5CKEW966

DATE: 05-17-2006

PLATE: 2 OF 2

CORRELATED SOIL PROPERTIES



NOTE: THE CORRELATED SOIL PROPERTIES (FRICTION ANGLE) ARE BASED ON MODIFIED ROBERTSON & CAMPANELLA METHOD.

CONE PENETROMETER TEST RESULTS - CPT CB3
GENTILLY LANDFILL
NEW ORLEANS, LOUISIANA

PLATE A-3b

APPENDIX C

STE
Soil Testing Engineers, Inc.
316 Highlandia Drive • P. O. Box 83710
Baton Rouge, Louisiana 70884
Telephone (225) 752-4790
FAX (225) 752-4878

Project: Gentilly LF   Client: Job #: 06-1046
By: GPB   Checked by: Date: Sheet SR-4 of

NEAR TOE:

X	P	P (ksf)
0	0	0
52	0.84	0.84
104	1.69	1.69
140	1.69+.58	2.27
188	1.69+.58+.78	3.05
248	1.69+.58+.78+.98	4.03
329	1.69+.58+.78+.98+1.24	5.26
428	1.69+.58+.78+.98+1.24+1.69	6.95
560	1.69+.58+.78+.98+1.24+1.69+2.14	9.10

① = 1.69 ksf (1.84)
② = .58
③ = .78
④ = .98
⑤ = 1.24

X LOAD   t when True Time =

X	LOAD	½	1½	2½	3½	4½	5½
52	0.84	0.5	1.5	2.5	3.5	4.5	5.5
104	1.69						

BORING L-2   Cv FOR LOAD

Zone	L (ft)	Type	OBO	①	②	③	④	⑤	⑥	⑦
4-17	9	OH, PT	0.42	.034	.023	.016	.012	.008	.006	.004
17-22	silt	silt	—							
22-36	5	CH	0.92	.022	.013	.008	.008	.007	.006	.004
36-48	4	CH	1.38	.020	.012	.008	.008	.007	.006	.004
48-54	6	CH	1.69	.013	.012	.008	.008	.007	.006	.005
54-55	silt	silt	—							
55-58	3	CH	1.92	.013	.012	.008	.008	.007	.006	.005

THUS

Cv / L² (1/day) FOR LOAD

Zone	1=1.69	2=+.58	3=+.78	4=+.98	5=+1.24	6=+1.69	7=+2.14
4-17	.00042	.00028	.00019	.00015	.00010	.00007	.00005
17-22	—	—	—				
22-36	.00088	.00052	.00032	.00032	.00029	.00024	.00016
36-48	.00125	.0005	.0005	.00044	.00040	.00038	.00025
48-54	.00036	.00033	.00022	.00022	.00019	.00017	.00014
54-55	—	—					
55-58	.00144	.0013	.00089	.00089	.00078	.00067	.00056

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Project: Gentilly LF Client: Job #: 06-1046
By: GPB Checked by: Date: Sheet SR-5 of

I Zone 4'-17'

1. X=52 T_c = .00042(90) = 0.04
t_c = 0.25 yr = 90 dys C_v/L^2 = .00042
LOAD ① ONLY

t yr	t	q	T_v	U	$I \Delta\sigma_v$ (I=.89)	ΔC=.28
1/4	90	90	0.038	.14	.11	.03
1/2	180	180	0.076	.25	.21	.06
1	360	360	0.151	.40	.34	.10
2	720	720	0.302	.65	.54	.15
3	1095	1095	0.460	.75	.63	.18
4	1460	1460	0.613	.84	.71	.20
5	1825	1825	0.766	.88	.74	.21
6	2190	2190	0.920	.92	.77	.22

2. X=104 T_c = .00042(180) = 0.08

t yr	t	q	T_v	U	$I \Delta\sigma_v$ (I=1.69)	ΔC=.28
1/4			.038	.07	.12	.03
1/2			.076	.18	.30	.08
1			.151	.38	.64	.18
2			.302	.60	1.01	.28
3			.460	.73	1.23	.34
4			.613	.82	1.39	.39
5			.766	.86	1.45	.41
6			.920	.92	1.55	.43

3. X=140 Load ① T_c = 0.08
Load ② T_c = .00028 × 360 = .102

TIME t yr	LOAD ① Δσ=1.69: t yr	T_v	U	$\Delta\sigma_v$	LOAD ② Δσ=0.58: t yr	T_v	U	$\Delta\sigma_v$	$\Sigma\Delta\sigma_v$	ΔC
1/4	.25			.12		0	0	0	.12	.03
1/2	.50			.30	0	0	0	0	.30	.08
1	1			.64	1/2	.051	.08	.05	.69	.12
2	2			1.01	1 1/2	.153	.35	.20	1.21	.33
3	3			1.23	2 1/2	.255	.53	.31	1.54	.43
4	4			1.39	3 1/2	.36	.64	.37	1.76	.49
5	5			1.45	4 1/2	.46	.70	.41	1.86	.52
6	6			1.55	5 1/2	.56	.77	.45	2.00	.56

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Project: Gentilly LF Client: Job #: 06-1046
By: GPB Checked by: Date: Sheet SR-6 of

I, 4'–17', CONT. $T_c = .00019(365) = .069$ $dq = 0.78$ ksf

X = 188' $T_V = .00019\ t_y \times 365 = .0694\ t_y$

TRUE t_y	LOADS ①+② $\Delta\sigma_V$	t_y (Load ③)	T_V	U	$\Delta\sigma_V$	$\Sigma\Delta\sigma_V$	ΔC_{28}
1/4	.12			0		.12	.03
1/2	.30			0		.30	.08
1	.69			0		.69	.19
2	1.21	1/2	.035	.07	.05	1.26	0.35
3	1.54	1 1/2	.104	.28	.22	1.76	0.49
4	1.76	2 1/2	.173	.43	.34	2.10	0.59
5	1.86	3 1/2	.243	.54	.42	2.28	0.64
6	2.00	4 1/2	.312	.62	.48	2.48	0.70

X = 248' q = .98 $T_c = .00015(365) = .055$
$T_V = .00015\ t_y \times 365$ $.0548\ t_y$

TRUE t_y	Loads ①-③ $\Delta\sigma_V$	t_y Load 4	T_V	U	$\Delta\sigma_V$		ΔC_{28}
				0			
1/4	.12	–		0			.03
1/2	.30	–		0			.08
1	.69	–		0			.19
2	1.26	–		0			.35
3	1.76	1/2	.027	.09	.09	1.85	.52
4	2.10	1 1/2	.082	.25	.24	2.34	.66
5	2.28	2 1/2	.137	.35	.34	2.62	.73
6	2.48	3 1/2	.192	.45	.44	2.92	.82

X = 324' q = 1.24 ksf $T_C = .00010(365) = .0365$

TRUE t_y	LOADS 1-4 $\Delta\sigma_V$	t_y	T_V	U	$\Delta\sigma_V$	$\Sigma\Delta\sigma_V$	ΔC_{28}
1/4	.12						.03
1/2	.30						.08
1	.69						.19
2	1.26						.35
3	1.85						.52
4	2.34	1/2	.018	.05	.06	2.40	.67
5	2.62	1 1/2	.055	.19	.24	2.86	0.80
6	2.92	2 1/2	.091	.30	.37	3.29	0.92

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FAX (225) 752-4878

Project: Gentilly LF Client: Job #: 06-1046
By: [illegible] Checked by: Date: Sheet 5R-7 of

$X = 428'$ (LOAD 6) = 1.69 ksf $T_c = .026$ $T_v = .0256\,t_y$

t_y	LOADS 1-5 $\Delta\sigma_v$	t_y	T_v	U	$\Delta\sigma_v$	$\Sigma\Delta\sigma_v$	$\Delta C_{.28}$
1/4	.12						0.03
1/2	.30						0.08
1	.60						0.19
2	1.26						0.35
3	1.85						0.52
4	2.40						0.67
5	2.86	1/2	.013	.06	.10	2.96	0.83
6	3.29	1 1/2	.038	.17	.29	3.58	1.00

$X = 560$ Load 7 = 2.14 ksf $T_c = 365(.00005) = .018$

t_y	$\Delta\sigma_v$ LOADS 1-6	t_y	T_v	U	$\Delta\sigma_v$	$\Sigma\Delta\sigma_v$	$C_{.28}$
1/4							.03
1/2							.08
1							.19
2							.35
3							.52
4							.67
5							.83
6	3.58	1/2	.009	.05	0.11	3.69	1.03

II. ZONE 22-36

1. $X = 52$ FT $T_c = .00088(90) = .079$
$T_v = t_{yR}(.321)$

$\sigma = .84$
LOAD (1) ONLY

t	T	T_v	U	$\Delta\sigma_v$	$\Delta C_{.28}$
1/4	.25	.08	.17	.14	.04
1/2	.50	.16	.39	.33	.09
1	1	.32	.61	.51	.14
2	2	.64	.80	.67	.19
3	3	.96	.90	.76	.21
4	4	1.28	.95	.80	.22
5	5	1.61	.98		.22
6	6	1.93	.99	.81	.23

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ZONE 22-36 $T_c = .16$ $q = 169$ ksf

II 2, X = 104'

t	τ	T_v	U	$\Delta\sigma_v$	Δc_{28}	
1/4		.08	.11	.19	.05	
1/2		.16	.31	.52	.15	.06
1		.32	.55	.93	.26	.07
2		.64	.80	1.35	.38	.08
3		.96	.70	1.32	.43	.09
4		1.28	.95	1.61	.45	.10
5		1.61	.96	1.62	.45	.11
6		1.93	.97	1.64	.46	.12

$q_3 = 0.58$
$\frac{T}{\Sigma\Delta\sigma} = .00052 \times$ [illegible] $= .190$

II.3 X = 140

t	τ	$\Delta\sigma$ (cont)	T_3	U_3	$\Delta\sigma_3$	$\Sigma\Delta\sigma$	Δc_{28}
1/4	0	.17	0	0	0		.105
1/2	0	.52	0	0	0		.15
1	1/2	.93	.095	.11	.06	.99	.28
2	1 1/2	1.35	.28	.46	.27	1.62	.45
3	2 1/2	1.52	.47	.67	.39	1.91	.53
4	3 1/2	1.61	.66	.80	.46	2.07	.58
5	4 1/2	1.62	.85	.86	.50	2.12	.59
6	5 1/2	1.64	1.04	.91	.53	2.17	.61

II.4 X = 188 $q_4 = 0.78$ ksf $c_v/h^2 = .00032$ $T_c = .12$

t	τ	$\Delta\sigma$ (2+3)	T_4	U_4	$\Delta\sigma_4$	$\Sigma\Delta\sigma$	ΔC_{28}
1/4		.19		0	0		.05
1/2		.52		0	0		.15
1		.99		0	0		.28
2	1/2	1.62	.058	.05	.04	1.66	.46
3	1 1/2	1.91	.175	.35	.27	2.18	.61
4	2 1/2	2.07	.29	.54	.42	2.49	.70
5	3 1/2	2.12	.41	.67	.52	2.64	.74
6	4 1/2	2.17	.53	.75	.58	2.75	.77

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II Zone 22'-36', CONT.

5. X = 248 q_5 = 0.98 c_v/L^2 = 0.00032/d = .117/yr

t	γ	$\Delta\sigma_v$ 1-4	T_5	U_5	$\Delta\sigma_5$	$\Sigma\Delta\sigma$	$\Delta C_{.28}$
1/4	–	.19					.05
1/2	–	.52					.15
1	–	.99					.28
2	–	1.66					.46
3	1/2	2.18	.059	.11	.11	2.29	0.64
4	1 1/2	2.49	.175	.37	.36	2.85	0.80
5	2 1/2	2.64	.292	.55	.54	3.18	0.89
6	3 1/2	2.75	.409	.66	.64	3.39	0.95

6. X = 324 q_6 = 1.24 ksf c_v/L^2 = 0.00024 T_c = .088

t	γ	$\Delta\sigma_v$ 1-5	T_6	U_6	$\Delta\sigma_6$	$\Sigma\Delta\sigma$	$\Delta C_{.28}$
1/4		.19					.05
1/2		.52					.15
1		.99					.28
2		166					.46
3		229					.64
4	1/2	2.85	.044	.08	.10	2.95	.83
5	1 1/2	3.18	.131	.31	.38	3.56	1.00
6	2 1/2	3.39	.219	.49	.61	4.00	1.12

X = 428 q_7 = 1.69 ksf c_v/L^2 = .00024 T_c = .088

t	γ	$\Delta\sigma_v$ 1-6	T_7	U_7	$\Delta\sigma_7$	$\Sigma\Delta\sigma$	$\Delta C_{.28}$
1/4							.05
1/2							.15
1							.28
2							.46
3							.64
4							.83
5	1/2	3.56	.044	.08	.14	3.70	1.03
6	1 1/2	4.00	.131	.31	.52	4.52	1.27

X = 560 q_8 = 2.14 ksf c_v/L^2 = .00016

t	γ				$\Delta\sigma_8$	$\Sigma\Delta\sigma$	
1/4 – 5							Same As X = 428
6	1/2		.029	.12	.26	4.78	1.34

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III ZONE 36'-48' C_0 = .51 ksf. $\Delta C = .28 \Delta\sigma$ q = .84 ksf

1. X = 52'
Recompress ½ Load ① ONLY c_v/L^2 = .00125/dy = 0.456/yr

t	T	T_v	$U_①$	$\Delta\sigma_1$	ΔC_1	C_1	
1/4	1/4	.114	.22	.18	.05	.56	
.5	.5	.23	.45	.38	.11	.62	2006
1	1	.45	.67	.56	.16	.67	07
2	2	.91	.92	.77	.22	.73	08
3	3	1.37	.97	.81	.23	.74	09
4	4	1.82	.98			.74	10
5	5	2.28	.99			.74	11
6	6	2.73	1.00	.84	.24	.75	12

2. X = 104' All Load ① q = 1.69 ksf c_v/L^2 = .456/yr. I_c = .23 (.46 × ½ yr)

t	T	T_v	$U_①$	$\Delta\sigma_1$	ΔC_1	C_1	
1/4	1/4	.114	.16	.27	.08	.59	
1/2	1/2	.23	.31	.52	.15	.66	2006 (Load 1 applied)
1	1	.45	.63	1.06	.30	.81	
2	2	.91	.87	1.47	.41	.92	
3	3	1.37	.95	1.60	.45	.96	
4	4	1.82	.97		.46	.97	
5	5	2.28	.99		.46	.97	
6	6	2.73	1.00	1.69	.47	.98	

3. X = 140' Load ② Δq = .58 ksf c_v/L^2 = .0005 1/dy = .1825/yr I_c = .18

t	T	$\Delta\sigma_①$	T_2	U_2	$\Delta\sigma_2$	$\Sigma\Delta\sigma$	ΔC	C	
1/4		.27						.59	
1/2		.52						.66	2006
1	.5	1.06	.091	.11	.06	1.12	.31	.82	2007 (Load 2 Applied)
2	1.5	1.47	.27	.47	.27	1.74	.49	1.00	2008
3	2.5	1.60	.46	.67	.39	1.99	.56	1.07	2009
4	3.5	1.64	.64	.80	.46	2.10	.59	1.10	2010
5	4.5	1.67	.82	.86	.50	2.17	.61	1.12	2011
6	5.5	1.69	1.00	.88	.51	2.20	.62	1.13	2012

4. X = 188' LOAD ③ = 0.78 ksf c_v/L^2 = .1825/yr T_c = .18

t	T	$\Delta\sigma_{1-2}$	T_3	U_3	$\Delta\sigma_3$	$\Sigma\Delta\sigma$	ΔC	C	
1/4		.27						.59	
1/2		.52						.66	2006
1		1.02						.82	2007
2	.5	1.74		.11	.09	1.83	.51	1.02	2008 Load 3 Applied
3	1.5	1.99		.47	.37	2.36	.66	1.17	2009
4	2.5	2.10		.67	.52	2.62	.73	1.24	2010
5	3.5	2.17		.80	.62	2.79	.78	1.29	2011
6	4.5	2.20		.86	.67	2.87	.80	1.31	2012

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III Zone 36-48, CONT.

5. X = 248, LOAD 4 = .98 ksf, cv/L² = .00044 x 365 = .161

t	τ	$\Delta\sigma_{-3}$	T_4	U_4	$\Delta\sigma_4$	$\Sigma\Delta\sigma$	ΔC	C	
1/4		.27						.59	
1/2		.53						.66	2006
1		1.12						.92	2007
2		1.83						1.02	2008
3	.5	2.36	.08	.11	.11	2.47	.69	1.20	2009
4	1.5	2.62	.29	.45	.44	3.06	.96	1.37	2010
5	2.5	2.79	.40	.64	.63	3.42	.96	1.47	2011
6	3.5	2.87	.56	.76	.74	3.61	1.01	1.52	2012

6. X = 324, LOAD 5 = 1.24 ksf, cv/L² = .00040 x 365 = .146/yr

t	τ	$\Delta\sigma_{1-4}$	T_5	U_5	$\Delta\sigma_5$	$\Sigma\Delta\sigma$	ΔC	C	
1/4		.27						.59	
1/2		.52						.66	06
1		1.13						.82	07
2		1.83						1.02	08
3		2.47						1.20	09
4	.5	3.06	.073	.11	.14	3.20	.90	1.41	10
5	1.5	3.42	.22	.42	.52	3.94	1.10	1.61	11
6	2.5	3.61	.36	.60	.74	4.35	1.22	1.73	12

7. X = 428 LOAD 6 = 1.63 ksf, cv/L² = .00035 = .128/yr

t	τ	$\Delta\sigma_{1-5}$	T_6	U_6	$\Delta\sigma_6$	$\Sigma\Delta\sigma$	ΔC	C	
1/4		.27						.59	
1/2		.52						.66	06
1		1.12						.82	07
2		1.83						1.02	08
3		2.47						1.20	09
4		3.20						1.41	10
5	.5	3.94	.064	.10	.17	4.11	1.15	1.66	11
6	1.5	4.35	.19	.37	.62	4.97	1.39	1.90	12

8. X = 560 LOAD 7 = 2.14 ksf, cv/L² = .00025 x 365 = .091

t	τ	$\Delta\sigma_{1-6}$	T_7	U_7	$\Delta\sigma_7$	$\Sigma\Delta\sigma$	ΔC	C	
1/4		.27						.59	
1/2		.52						.66	06
1		1.12						.82	07
2		1.83						1.02	08
3		2.47						1.20	09
4		3.20						1.41	10
5		4.11						1.66	11
6	.5	4.97	.046	.09	.19	5.16	1.45	1.96	12

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IV ZONE 48-54 C_o = 0.60 ksf CPT

1. x = 52' $\bar{\sigma}$ = ½ (1.69) = .84 ksf c_v/L^2 = .000361/d = .131/yr T_c = .066

t	T	T_v	U_1	$\Delta\sigma_1$	Δc_1	c	
1/4	1/4	.033	.07	.06	.02	.62	
1/2	1/2	.066	.19	.16	.04	.64	2006
1	1	.131	.37	.31	.09	.69	07
2	2	.26	.53	.45	.12	.72	08
3	3	.39	.68	.57	.16	.76	09
4	4	.52	.77	.65	.18	.78	10
5	5	.66	.84	.71	.20	.80	11
6	6	.78	.88	.74	.21	.81	12

2. x = 104' $\bar{\sigma}$ = 1.69 ksf c_v/L^2 = .131/yr T_c = .13

t	T	T_v	U_1	$\Delta\sigma_1$	Δc_1	c	
1/4	1/4	.033	.04	.07	.02	.62	
1/2	1/2	.066	.10	.17	.05	.65	2006
1	1	.13	.24	.41	.11	.71	07
2	2	.26	.49	.83	.23	.83	08
3	3	.39	.64	1.08	.30	.90	09
4	4	.52	.74	1.25	.35	.95	10
5	5	.66	.83	1.40	.39	.99	11
6	6	.78	.867	1.47	.41	1.01	12

3. x = 140' $\bar{\sigma}$ = .58 ksf c_v/L^2 = .00033 = .120 T_c = .12

t	T	$\Delta\sigma_1$	T_2	U_2	$\Delta\sigma_2$	$\Sigma\Delta\sigma$	Δc_2	C_2	
1/4		.07						.62	
1/2		.17						.65	2006
1	.5	.41	.060	.09	.05	.46	.13	.73	07
2	1.5	.83	.18	.38	.22	1.05	.29	.89	08
3	2.5	1.08	.30	.55	.32	1.40	.39	.99	09
4	3.5	1.25	.42	.66	.38	1.63	.46	1.06	10
5	4.5	1.40	.54	.75	.44	1.84	.51	1.11	11
6	5.5	1.47	.66	.83	.48	1.95	.55	1.15	12

4. x = 188 Lid $\bar{\sigma}$ = 0.78 ksf c_v/L^2 = .00022 1/d = .0803

t	T	$\Delta\sigma_{1-2}$	T_3	U_3	$\Delta\sigma_3$	$\Sigma\Delta\sigma$	Δc_3	C_3	
1/4		.07							
1/2		.17							2006
1		.46							07
2	.5	1.05	.04	.10	.08	1.13	.32	.92	08
3	1.5	1.40	.12	.30	.23	1.63	.46	1.06	09
4	2.5	1.63	.20	.45	.35	1.98	.55	1.16	10
5	3.5	1.84	.28	.56	.44	2.28	.64	1.24	11
6	4.5	1.95	.36	.65	.67	2.46	.69	1.29	12

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IV ZONE 4S-5A CONT $C_c = 0.60$ kcf per CPT

5. X = 248', LOAD (4) = 0.98 ksf, c_v/L^2 = .00022 1/d = .0803 1/yr

t	T	$\Delta\sigma_{1-3}$	T_4	U_4	$\Delta\sigma_4$	$\Sigma\Delta\sigma$	ΔC_4	C_4	
1/4		.07						.62	
1/2		.17						.65	06
1		.46						.73	07
2		1.13						.92	08
3	.5	1.63	.04	.10	.10	1.73	.48	1.08	09
4	1.5	1.98	.12	.30	.29	2.28	.64	1.24	10
5	2.5	2.28	.20	.45	.44	2.72	.76	1.36	11
6	3.5	2.46	.28	.56	.55	3.01	.84	1.44	12

6. X = 324', LOAD (5) = 1.24 ksf, c_v/L^2 = .00019 1/d = .0694 1/yr

t	T	$\Delta\sigma_{1-4}$	T_5	U_5	$\Delta\sigma_5$	$\Sigma\Delta\sigma$	ΔC_5	C_5	
1/4		.07						.62	
1/2		.17						.65	06
1		.46						.73	07
2		1.13						.92	08
3		1.73						1.08	09
4	.5	2.28	.035	.07	.09	2.37	.66	1.26	10
5	1.5	2.72	.104	.25	.31	3.03	.85	1.45	11
6	2.5	3.01	.17	.40	.50	3.51	.98	1.58	12

7. X = 428', LOAD (6) = 1.69 ksf, c_v/L^2 = .00017 1/d = .0621 1/yr

t	T	$\Delta\sigma_{1-5}$	T_6	U_6	$\Delta\sigma_6$	$\Sigma\Delta\sigma$	ΔC_6	C_6	
1/4		.07						.62	
1/2		.17						.65	06
1		.46						.73	07
2		1.13						.92	08
3		1.73						1.08	09
4		2.37						1.26	10
5	.5	3.03	.031	.07	.12	3.15	.88	1.48	11
6	1.5	3.51	.093	.24	.41	3.92	1.10	1.70	12

8. X = 560' Load (7) = 2.14 ksf, c_v/L^2 = .00014 1/d = .051 1/yr

t	T	$\Delta\sigma_{1-6}$	T_7	U_7	$\Delta\sigma_7$	$\Sigma\Delta\sigma$	ΔC_7	C_7	
1/4		.07							
1/2		.17							
1		.46							
2		1.13							
3		1.73							
4		2.37							
5		3.15							
6	.5	3.92	.026	.06	.13	4.05	1.13	1.73	2012

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V Zone 54–58 $c_0 = 0.65$ ksf CPT

1. $x = 52$ ft $q = .84$ ksf $c_v/L^2 = .00144$ 1/day $= 0.526$ 1/yr $T_0 = .26$

t	Y	T_0	U_0	$\Delta\sigma_0$	ΔC_0	C_0	
1/4	.25	.13	.12	.10	.03	.68	
1/2	.50	.26	.24	.20	.06	.71	06
1	1	.52	.62	.52	.15	.80	07
2	2	1.05	.90	.76	.21	.86	08
3	3	1.58	.96	.80	.23	.88	09
4	4	2.10	.98	.82		.88	10
5	5	2.63	1.00	.84	.24	.89	11
6	6	3.15	1.00	.84		.89	12

2. $x = 104'$ $q = 1.69$ ksf $c_v/L^2 = .00144$/day $= .526$ 1/yr $T_c = .53$

t	Y	T_1	U_1	$\Delta\sigma_1$	ΔC_1	C_1	
1/4	.25	.13	.07	.12	.03	.68	
1/2	.50	.26	.20	.34	.09	.74	06
1	1	.52	.57	.96	.27	.92	07
2	2	1.05	.88	1.49	.42	1.06	08
3	3	1.58	.95	1.60	.45	1.10	09
4	4	2.10	.98	1.66	.46	1.11	10
5	5	2.63	1.00	1.69	.47	1.12	11
6	6	3.15	1.00	1.69	.47	1.12	12

3. $x = 140'$ $q_2 = 0.58$ ksf, $c_v/L^2 = .0013 = .474$/yr $T_c = .47$

t	Y	$\Delta\sigma_1$	T_2	U_2	$\Delta\sigma_2$	$\Sigma\Delta\sigma$	ΔC_2	C_2	
1/4		.12						.68	
1/2		.34						.74	06
1	.5	.96	.24	.20	.12	1.08	.30	.95	07
2	1.5	1.49	.71	.75	.43	1.92	.54	1.19	08
3	2.5	1.60	1.19	.92	.53	2.13	.60	1.25	09
4	3.5	1.66	1.66	.96	.56	2.22	.62	1.27	10
5	4.5	1.69	2.14	.98	.57	2.26	.63	1.28	11
6	5.5	1.69	2.61	1.00	.58	2.27	.64	1.29	12

4. $x = 188'$ $q_3 = 0.78$ ksf, $c_v/L^2 = .00089$ 1/day $= 0.325$/yr

t	Y	$\Delta\sigma_{1,2}$	T_3	U_3	$\Delta\sigma_3$	$\Sigma\Delta\sigma$	ΔC_3	C_3	
1/4		.12						.68	
1/2		.34						.74	06
1		1.08						.95	07
2	.5	1.92	.10	.15	.12	2.04	.57	1.22	08
3	1.5	2.13	.48	.60	.47	2.60	.73	1.38	09
4	2.5	2.22	.81	.82	.64	2.86	.80	1.45	10
5	3.5	2.26	1.14	.91	.71	2.97	.83	1.48	11
6	4.5	2.27	1.46	.95	.74	3.01	.84	1.49	12

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5. X = 248' LOAD (4) = 0.98 ksf, c_v/L^2 = .00089/d = .3248/yr

t	T	$\Delta\sigma_{1-3}$	T_4	U_4	$\Delta\sigma_4$	$\Sigma\Delta\sigma$	ΔC_4	C_4
1/4		.12						.68
1/2		.34						.74
1		1.08						.95
2		2.04						1.22
3	.5	2.60	.16	.15	.15	2.75	.77	1.42
4	1.5	2.86	.49	.60	.59	3.45	.96	1.62
5	2.5	2.97	.81	.82	.80	3.77	1.06	1.71
6	3.5	3.01	1.14	.91	.89	3.90	1.09	1.74

6. X = 324' LOAD (5) = 1.24 ksf c_v/L^2 = .00078 1/d = .2847/yr

t	T	$\Delta\sigma_{1-4}$	T_5	U_5	$\Delta\sigma_5$	$\Sigma\Delta\sigma$	ΔC_5	C_5
1/4		.12						.68
1/2		.34						.74
1		1.08						.95
2		2.04						1.22
3		2.75						1.42
4	.5	3.45	.14	.15	.19	3.64	1.01	1.66
5	1.5	3.77	.43	.58	.72	4.49	1.26	1.91
6	2.5	3.90	.71	.80	.99	4.89	1.37	2.02

7. X = 428' LOAD (6) = 1.69 ksf c_v/L^2 = .00067 1/d = .2446/yr

t	T	$\Delta\sigma_{1-5}$	T_6	U_6	$\Delta\sigma_6$	$\Sigma\Delta\sigma$	ΔC_6	C_6	
1/4		.12						.68	
1/2		.34						.74	06
1		1.08						.95	07
2		2.04						1.22	08
3		2.75						1.42	09
4		3.64						1.66	10
5	.5	4.49	.12	.12	.20	4.69	1.31	1.96	11
6	1.5	4.89	.37	.53	.90	5.79	1.62	2.27	12

8. X = 520' LOAD (7) = 2.14 ksf c_v/L^2 = .00056 1/d = .2044 1/yr

t	T	$\Delta\sigma_{1-6}$	T_7	U_7	$\Delta\sigma_7$	$\Sigma\Delta\sigma$	ΔC_7	C_7
1/4		.12						
1/2		.34						
1		1.08						
2		2.04						
3		2.75						
4		3.64						
5		4.69						
6	.5	5.79	.10	.12	.26	6.05	1.69	2.34

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Project: Gentilly LF Client: Job #: 06-1046
By: GPR Checked by: Date: Sheet SR-16 of

VERY ROUGHLY! $\gamma = 65$ $H = 140$

$$H_s = 5.53 \frac{\bar{c}}{\gamma}$$

$$140 = 5.53 \frac{\bar{c}/SF}{65}$$

$C = SF \times 1645$ (Vertical cut, No N_d)

ıplied at the
ment at any

. . . . . . (7)

obtained by
egrating Eq.
is simplified

Fig. 1) with
applied load

. . . . (8a)

. . . . (8b)

. . . . (8c)

. . . . (8d)

elevant T –

30	0.060	17	1.7								
50	0.100	27	2.7	0	0	0	0				
100	0.200	47	4.7	50	0.100	21	4.2				
200	0.400	68	6.8	150	0.300	57	11.4	0	0	0	0
400	0.800	89	8.9	350	0.700	84	16.8	200	0.400	70	−7.0

$T_c = \frac{c_v t_c}{L^2}$

OLSON, 1977

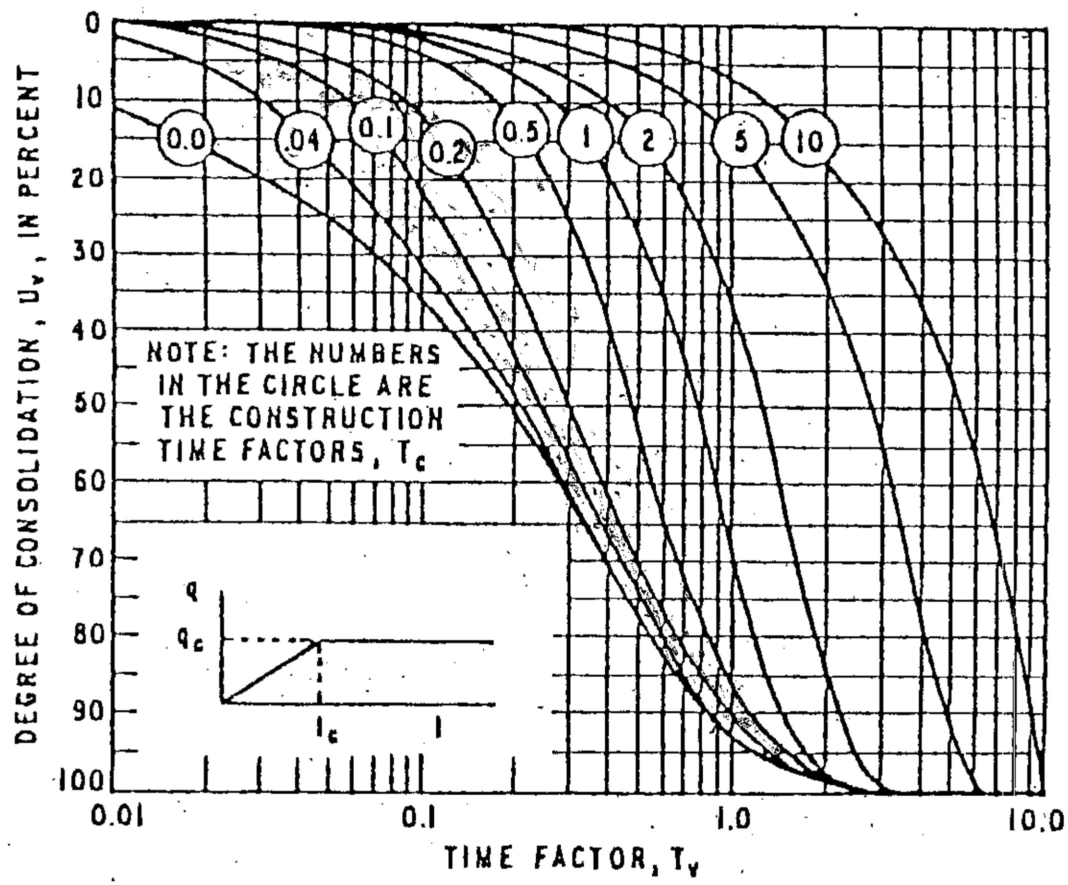

FIG. 1.—$U_v - T$ Curves for One-Dimensional Vertical Flow and Single Ramp

be obtained by simply adding the solutions for each of the constituent lo
As an example of the analysis, consider a case with the same soil co

From Lambe + Whitman

equation applicable to numerous physical problems. In particular, the equations for transient heat flow are basically identical to these equations for consolidation, with temperature replacing excess pore pressure. Solutions have been obtained for many problems in heat flow involving a variety of initial and boundary conditions, and these solutions often may be used to considerable advantage in the study of consolidation.

27.2 SOLUTION FOR UNIFORM INITIAL EXCESS PORE PRESSURE

The simplest case of consolidation is the one-dimensional problem in which: (*a*) the total stress is constant with time, so that $\partial\sigma_v/\partial t = 0$; (*b*) the initial excess pore pressure is uniform with depth; and (*c*) there is drainage at both the top and bottom of the consolidating stratum. These conditions are met by the loading in Fig. 26.2 provided that the loading is applied in a time that is very small compared to the consolidation time so that literally no consolidation occurs before the loading is complete. The total vertical stress at any point will then be constant during the consolidation process.

For this problem, it is convenient to convert Eq. 27.4 by introducing nondimensional variables:

$$Z = \frac{z}{H} \tag{27.8a}$$

$$T = \frac{c_v t}{H^2} \tag{27.8b}$$

where z and Z are measured from the top of the consolidating stratum and H is *one-half* of the thickness of the consolidating stratum. (The reason for this choice of H will be apparent later.) The nondimensional time T is called the *time factor*. With these variables, Eq. 27.4 becomes

$$\frac{\partial^2 u_e}{\partial Z^2} = \frac{\partial u_e}{\partial T} \tag{27.9}$$

We now need a solution to Eq. 27.9 satisfying the following conditions:

Initial condition at $t = 0$:

$$u_e = u_0 \text{ for } 0 \leq Z \leq 2$$

Boundary condition at all t:

$$u_e = 0 \text{ for } Z = 0 \text{ and } Z = 2$$

0

59

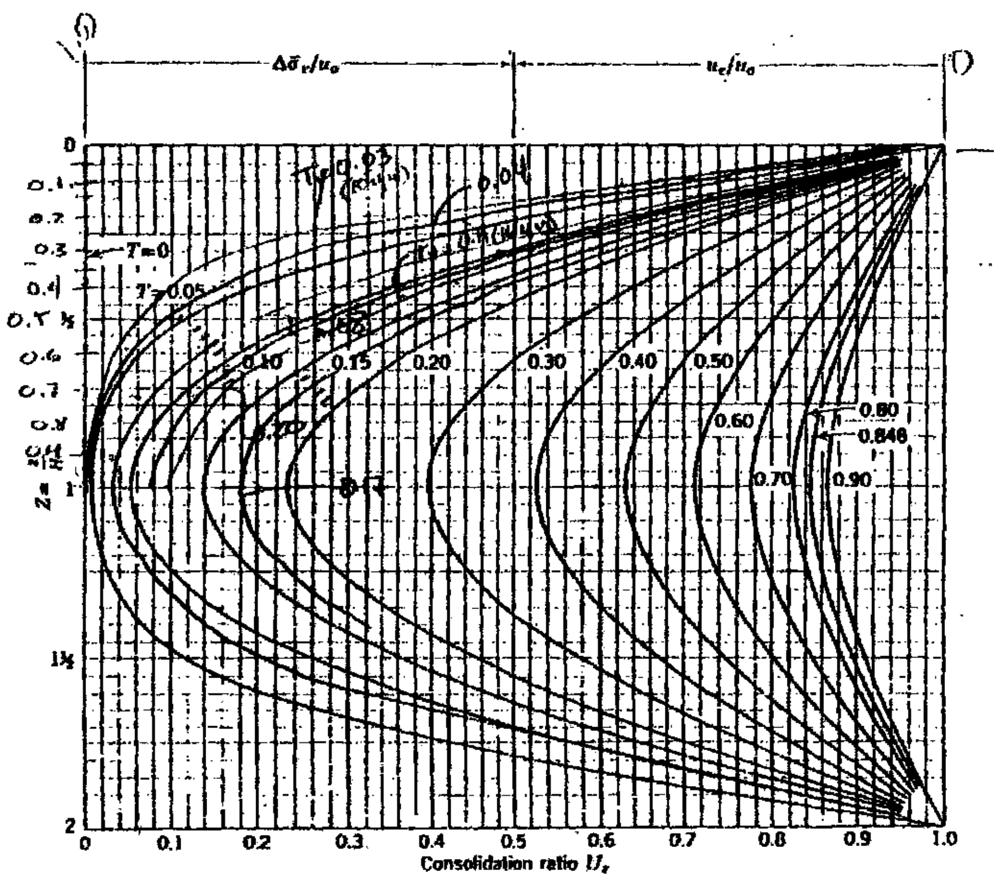

Fig. 27.2 Consolidation ratio as function of depth and time factor: uniform initial excess pore pressure.

...ere u_0 is the initial excess pore pressure. The solution (e.g., see Taylor 1948)

$$u_e = \sum_{m=0}^{m=\infty} \frac{2u_0}{M}(\sin MZ)e^{-M^2T} \tag{27.10}$$

...here

$$M = \frac{\pi}{2}(2m + 1) \tag{27.11}$$

and m is a dummy variable taking on values 1, 2, 3, ... This solution may be conveniently portrayed in graph form (Fig. 27.2) where the consolidation ratio

$$U_z = 1 - \frac{u_e}{u_0}$$

is shown as a function of Z and T.

Example 27.1 illustrates the use of Fig. 27.2 to evaluate excess pore pressure, velocity of flow, and effective

▸**Example 27.1**

Given. The stratum of clay and loading shown in Fig. E27.1-1. This is the same profile and loading as in Example 25.6.

Find. At elevation −27.5 ft and 4 months after loading

a. Excess pore pressure.

b. Pore pressure.

c. Vertical effective stress.

d. Velocity of flow.

Solution. Because the overlying and underlying soils are much more permeable than the clay, there is double drainage.

$$H = 7 \text{ ft}, \quad Z = \frac{(27.5 - 24)}{7} = 0.5, \quad T = \frac{13.6(0.33)}{(7)^2} = 0.092$$

Interpolating in Fig. 27.2, $U_z = 0.24$

Thus:

$$u_e = 2.1(1 - 0.24) = 1.60 \text{ ksf}$$

$$u = \bar{u}_{ss} + u_e = 1.13 + 1.60 = 2.73 \text{ ksf}$$

$$\bar{\sigma}_v = (\bar{\sigma}_v)_0 + \Delta\bar{\sigma}_v = 1.27 + 2.1(0.24) = 1.27 + 0.50 = 1.77 \text{ ksf}$$

The stresses and pore pressures after 4 months are shown in Fig. E27.1-2. The slope of the tangent at $Z = 0.5$ to the interpolated curve for $T = 0.092$ is shown in Fig. E27.1-3. In terms of gradient this becomes

$$i = \frac{1}{\gamma_w}\frac{U_z}{Z}\frac{u_0}{H} = \frac{(0.95)(2.10)}{(0.0624)(7)} = 4.56$$

The superficial seepage velocity is thus

$$v = ki = 0.06(4.56) = 0.27 \text{ ft/yr upward}$$

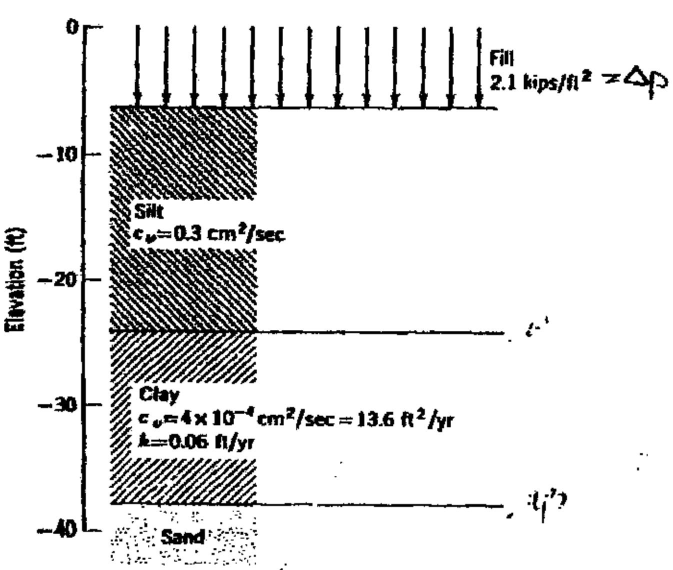

Fig. E27.1-1

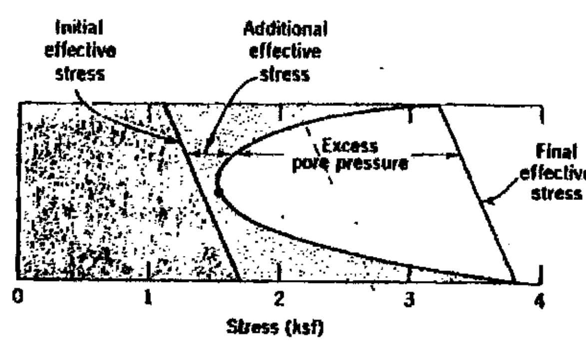

Fig. E27.1-2

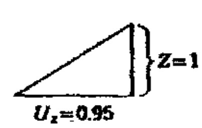

Fig. E27.1-3

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Project: Gentilly LF Client: LA DEQ Job #: 06-1046
By: CA Checked by: Date: 7/18/06 Sheet 1 of

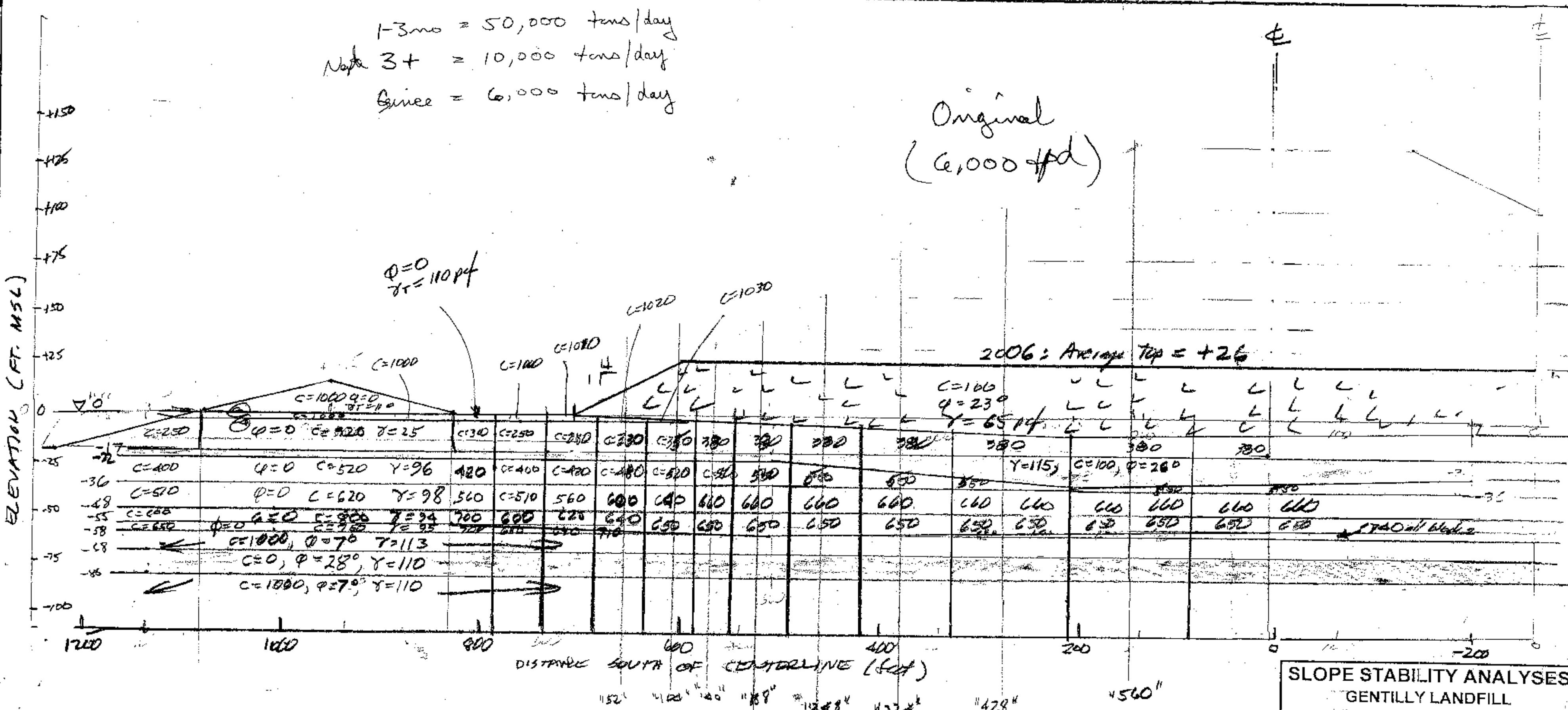
Year 2006

Depth (EL) | ELO L-1 | γ(pcf) | C (psf) | φ (deg) | θ | Wc | Su/P = 0.28

Depth (ft)		L-1	γ (pcf)	C (psf)	φ (deg)	Layer bottom
0–14		CH	100	250	0	14
14–20		PT	80	250	0	20
20–34	Vo	CH	96	400	0	34
34–52	So	CH	96	500	0	52
52–58	WSt	CH	95	650	0	58
58–72	St	CH	110	1000	4°	72
72–80	Vde	SA	110	0	30°	80

Depth scale: 0, 5, 10, 15, 20, 25, 30, 35, 40, 45, 50, 55, 60, 65, 70, 80

(ETL)



Note: Vertical Exaggeration 2X

1200 = C_0 + 1700 Tan φ
C_0=1000 φ=7°

SLOPE STABILITY ANALYSES
GENTILLY LANDFILL
NEW ORLEANS, LOUISIANA

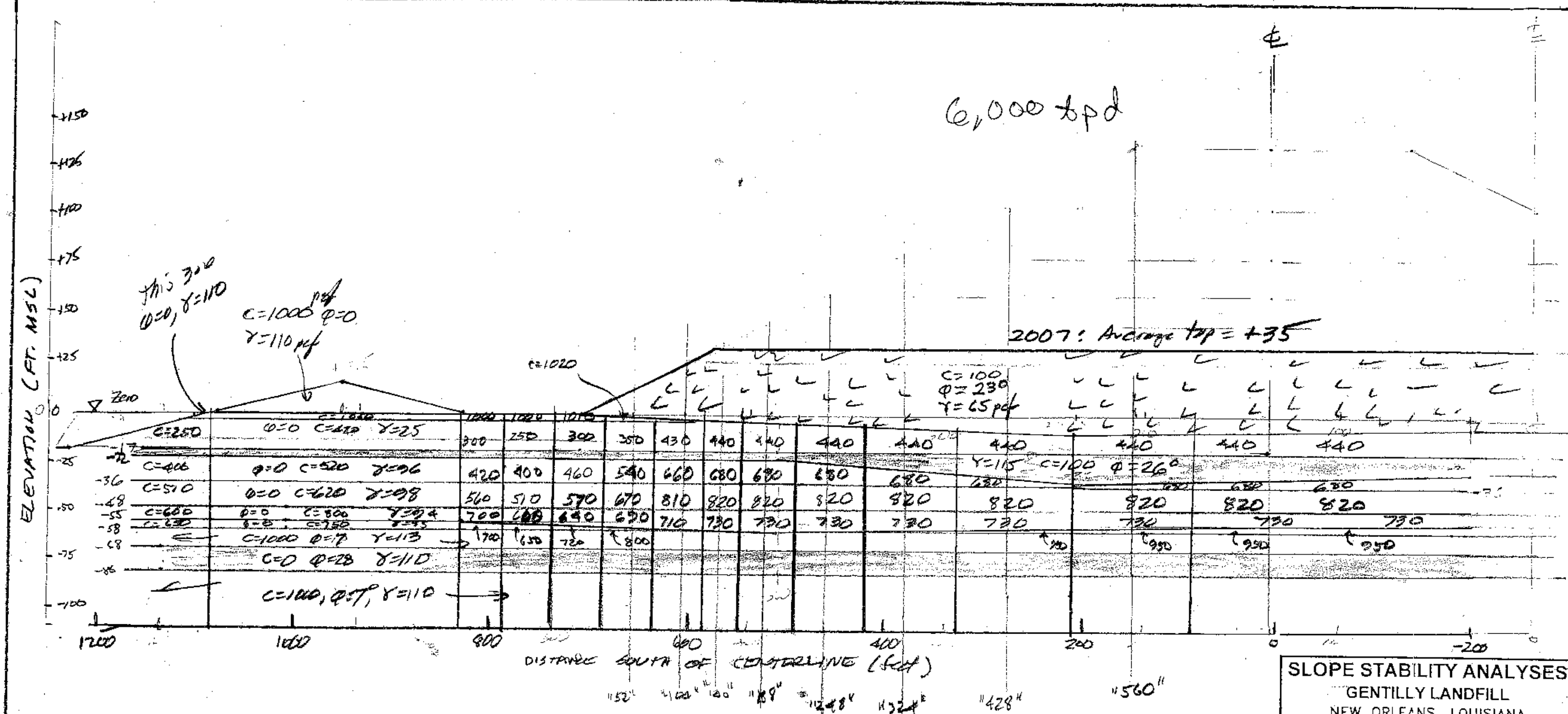
for

LOUISIANA DEPARTMENT OF ENVIRONMENTAL QUALITY
OFFICE OF ENVIRONMENTAL SERVICES
BATON ROUGE, LOUISIANA

STE Soil Testing Engineers, Inc.
Baton Rouge, LA Jefferson, LA Biloxi, MS

Project Engineer: G.P. Boutwell	Drawn by: DMS	Checked by:
File No.: 06-1046	Date: 6-17-06	Figure No.:

Title: STABILITY ANALYSIS NS-02 :



SLOPE STABILITY ANALYSES
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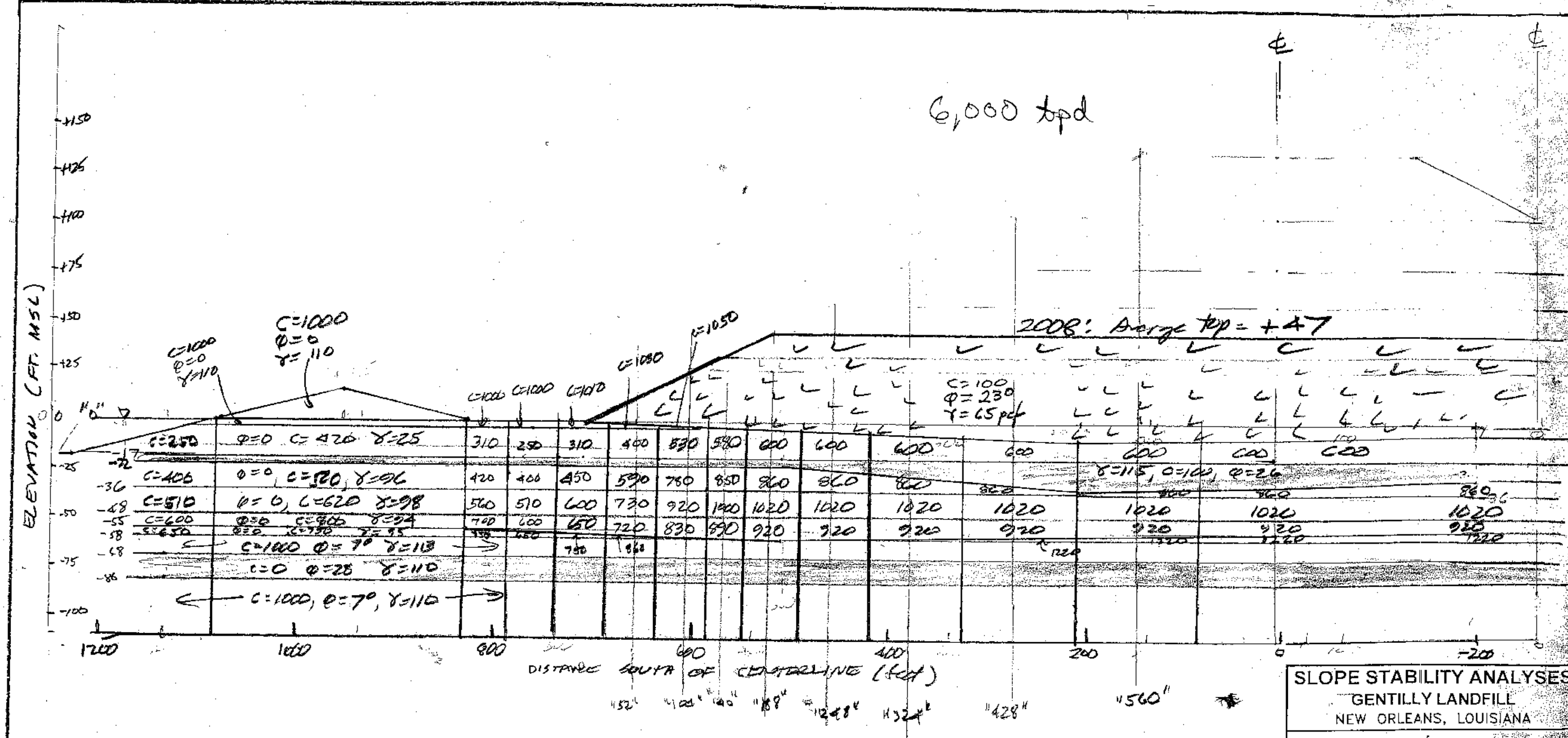
G.P. Boutwell	DMS	
File No.: 06-1046	Date: 6-17-06	Figure No.:

Title: STABILITY ANALYSIS NS-02

Note: Vertical Exaggeration 2X



Note: Vertical Exaggeration 2X

SLOPE STABILITY ANALYSES
GENTILLY LANDFILL
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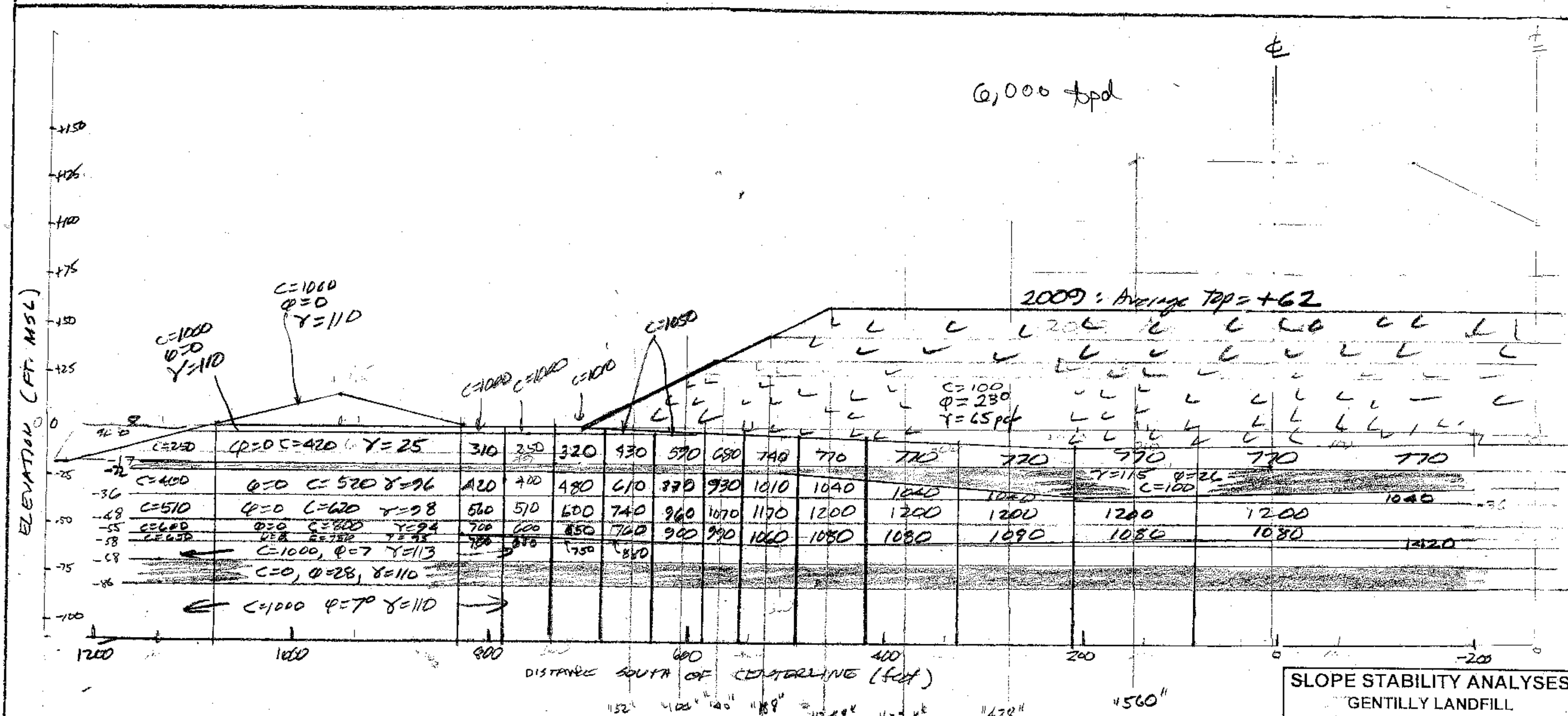
Project Engineer: G.P. Boutwell	Drawn by: DMS	Checked by:
File No.: 06-1046	Date: 6-17-06	Figure No.

Title: STABILITY ANALYSES
NS-02



Note: Vertical Exaggeration 2X

SLOPE STABILITY ANALYSES
GENTILLY LANDFILL
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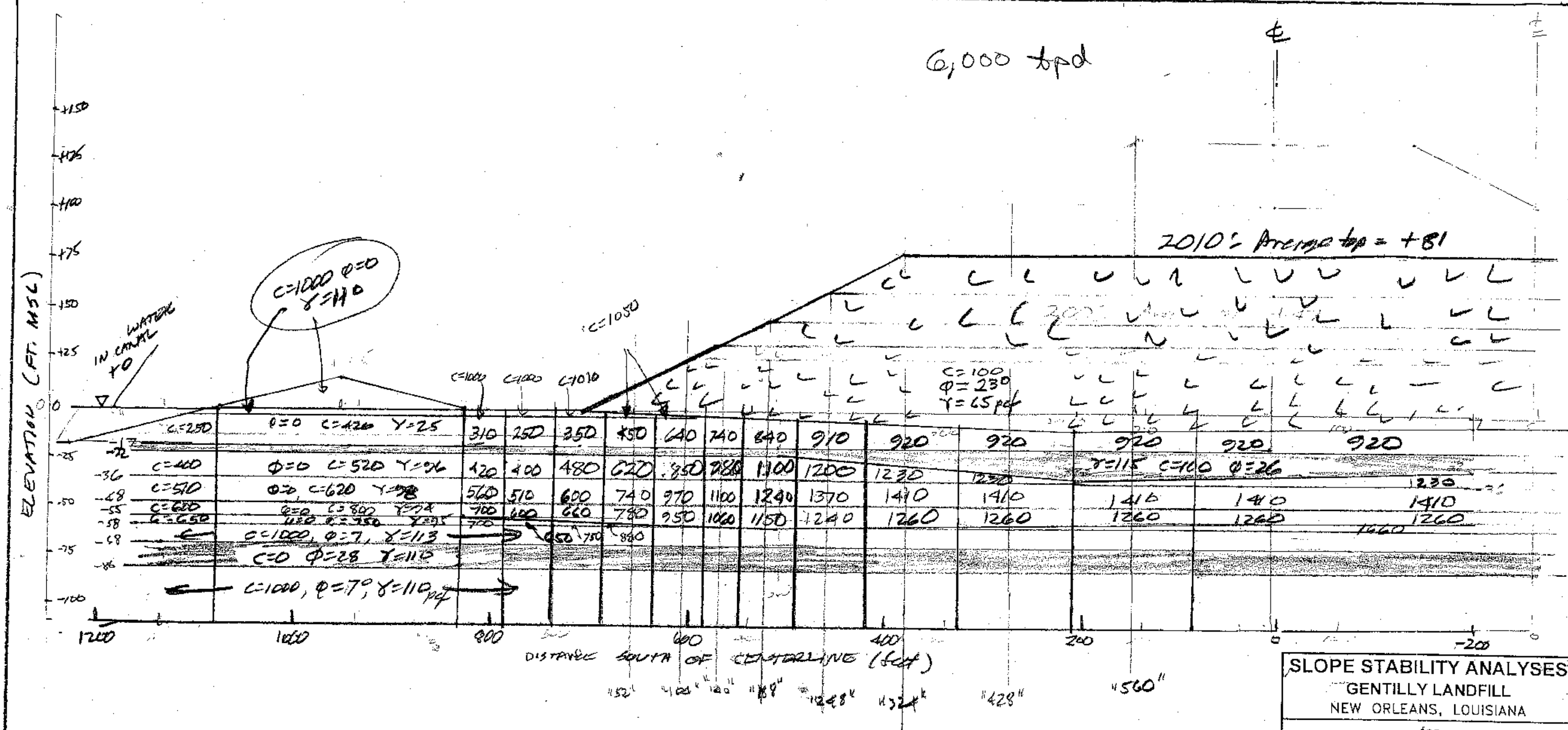

Note: Vertical Exaggeration 2X

SLOPE STABILITY ANALYSES
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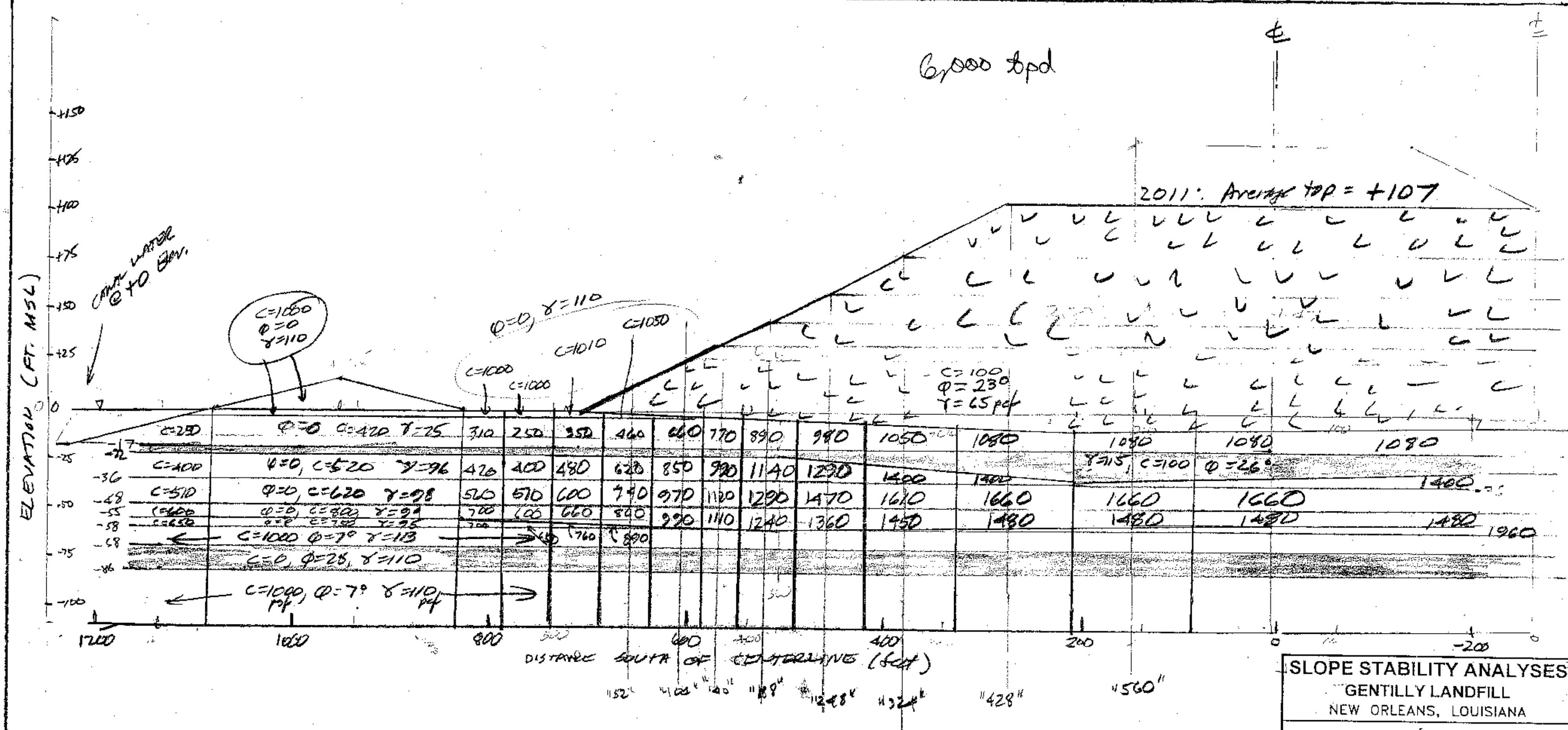
Title: STABILITY ANALYSIS NS-02



Note: Vertical Exaggeration 2X

SLOPE STABILITY ANALYSES
GENTILLY LANDFILL
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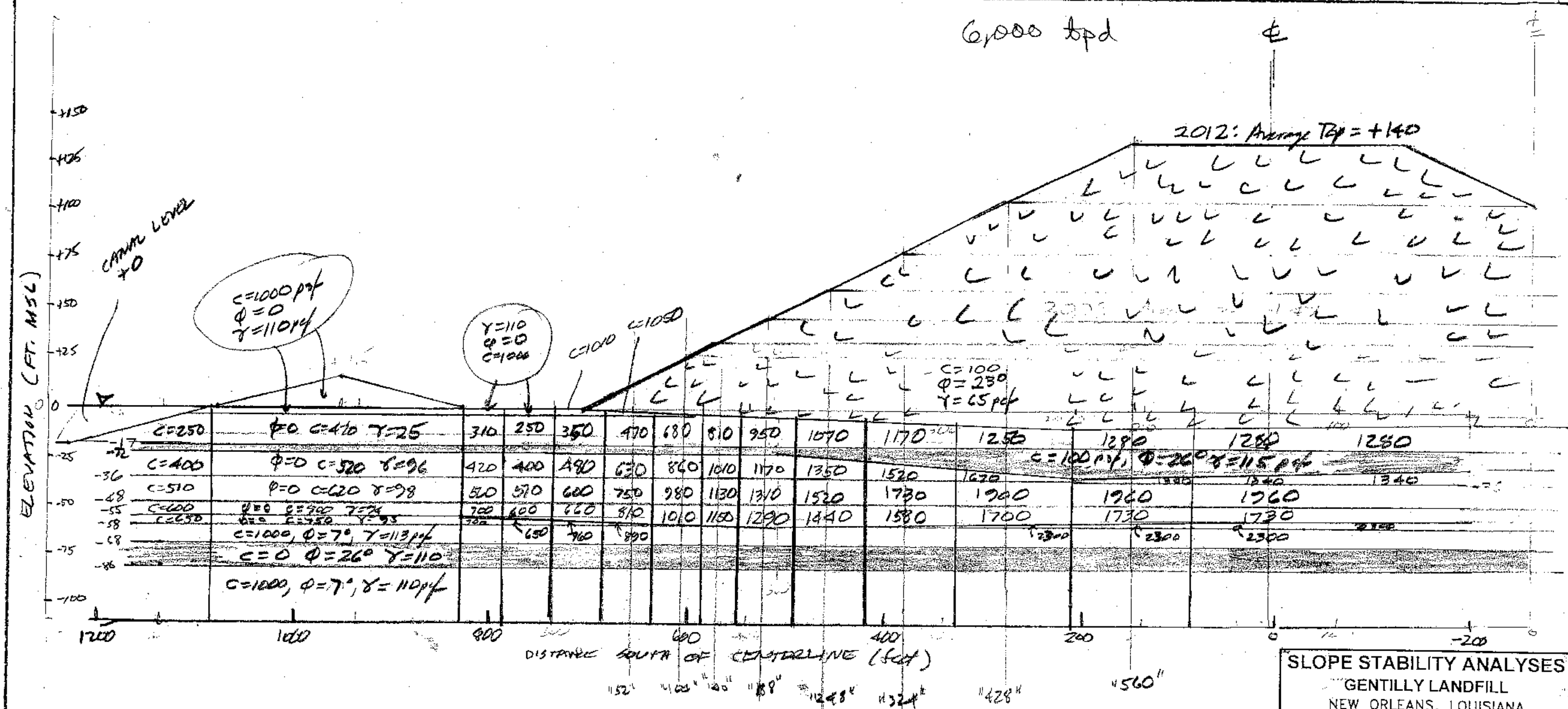
File No.: 06-1046	Date: 6-17-06	Figure No.:

Title: STABILITY ANALYSES
NS-02



Note: Vertical Exaggeration 2X

SLOPE STABILITY ANALYSES
GENTILLY LANDFILL
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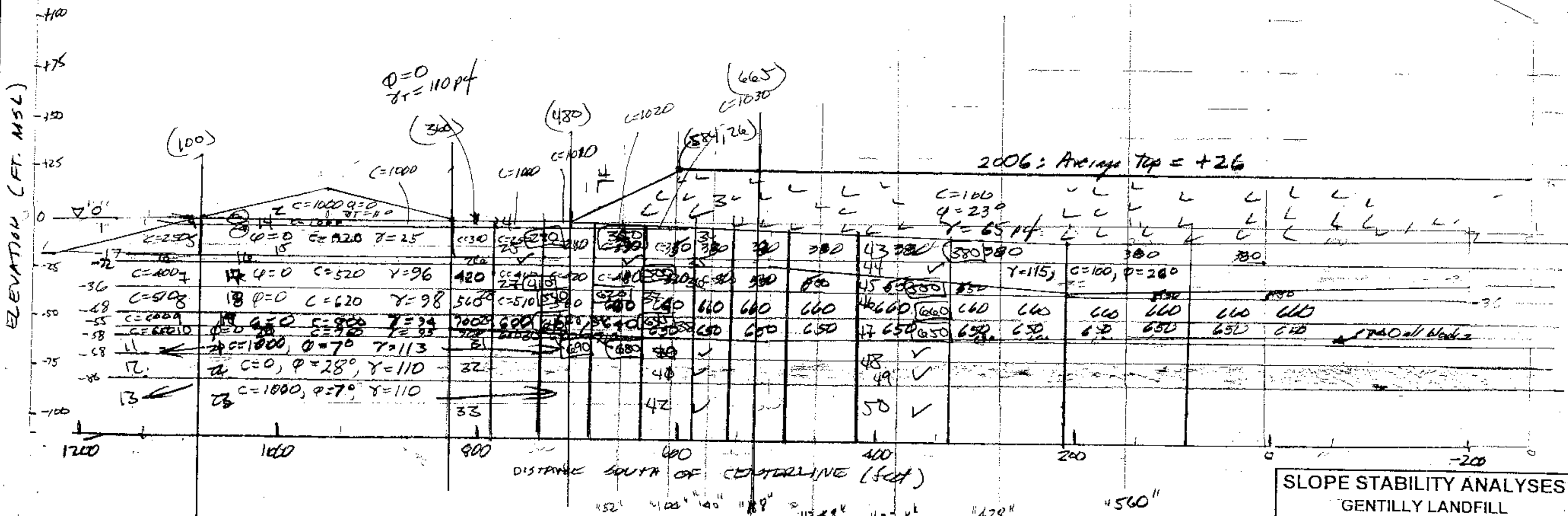
G.P. Boutwell	DMS	
File No.: 06-1046	Date: 6-17-06	Figure No.:

Title: STABILITY ANALYSIS NS-02

1-3 mo = 50,000 tons/day
Night 3+ = 10,000 tons/day
Genie = 6,000 tons/day

For Max. fill + others (6,000 tpd)



Year 2006

Note: Vertical Exaggeration 2X

1200 = ℄ + 1700 Top φ
c_0=1000 φ=7°

SLOPE STABILITY ANALYSES
GENTILLY LANDFILL
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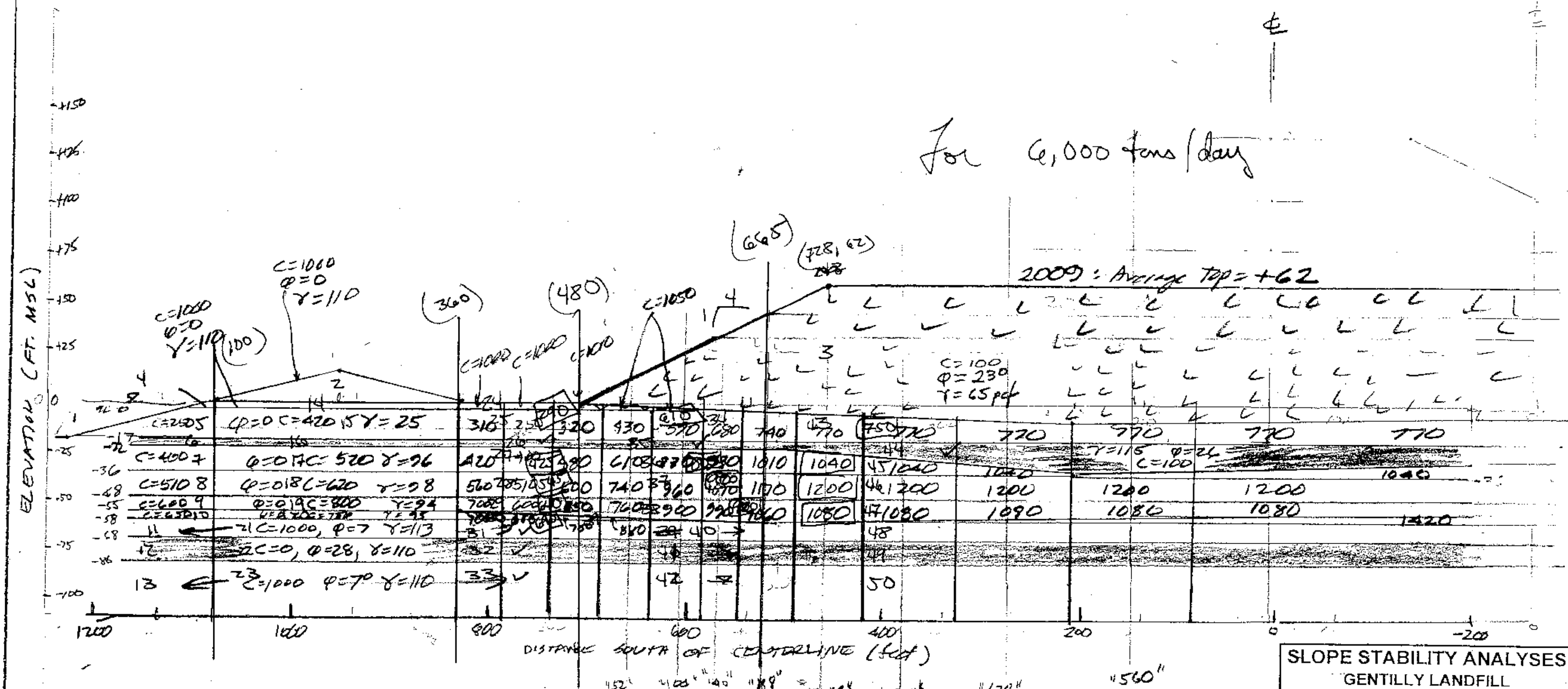

Year 2009

Note: Vertical Exaggeration 2X

SLOPE STABILITY ANALYSES
GENTILLY LANDFILL
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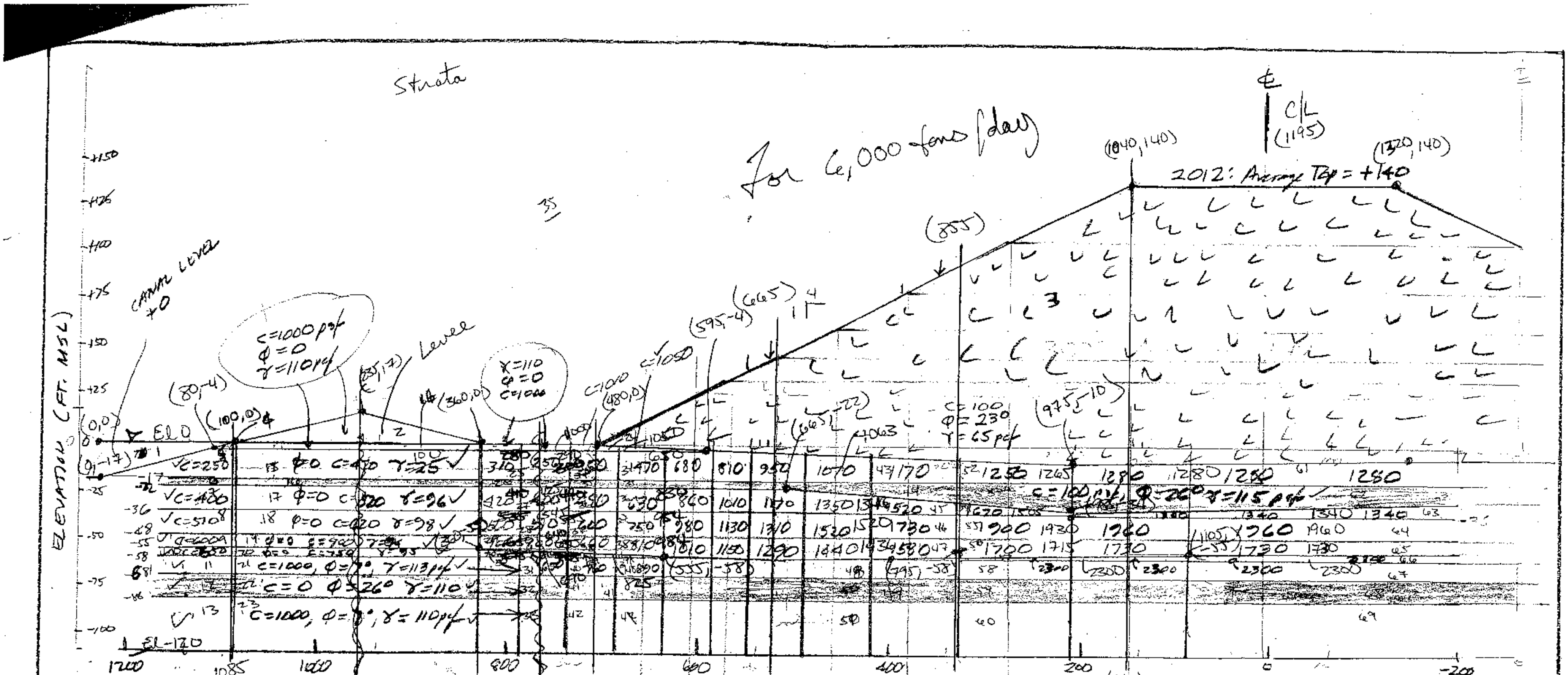

- Bijan . sharafkhani @ LA.Gov

"52" "100" "40" "88" "1248" "324" "428" "560"

El +140 = 1.42 (670/420)

El +130 = 1.53 (670/420)

El +135 = 1.47 (670/420)

250/850
450/100

700,-16
900,-16
700,-16

Note: Vertical Exaggeration 2X

Year 2012

SLOPE STABILITY ANALYSES
GENTILLY LANDFILL
NEW ORLEANS, LOUISIANA

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File No.: 06-1046	Date: 6-17-06	Figure No.:

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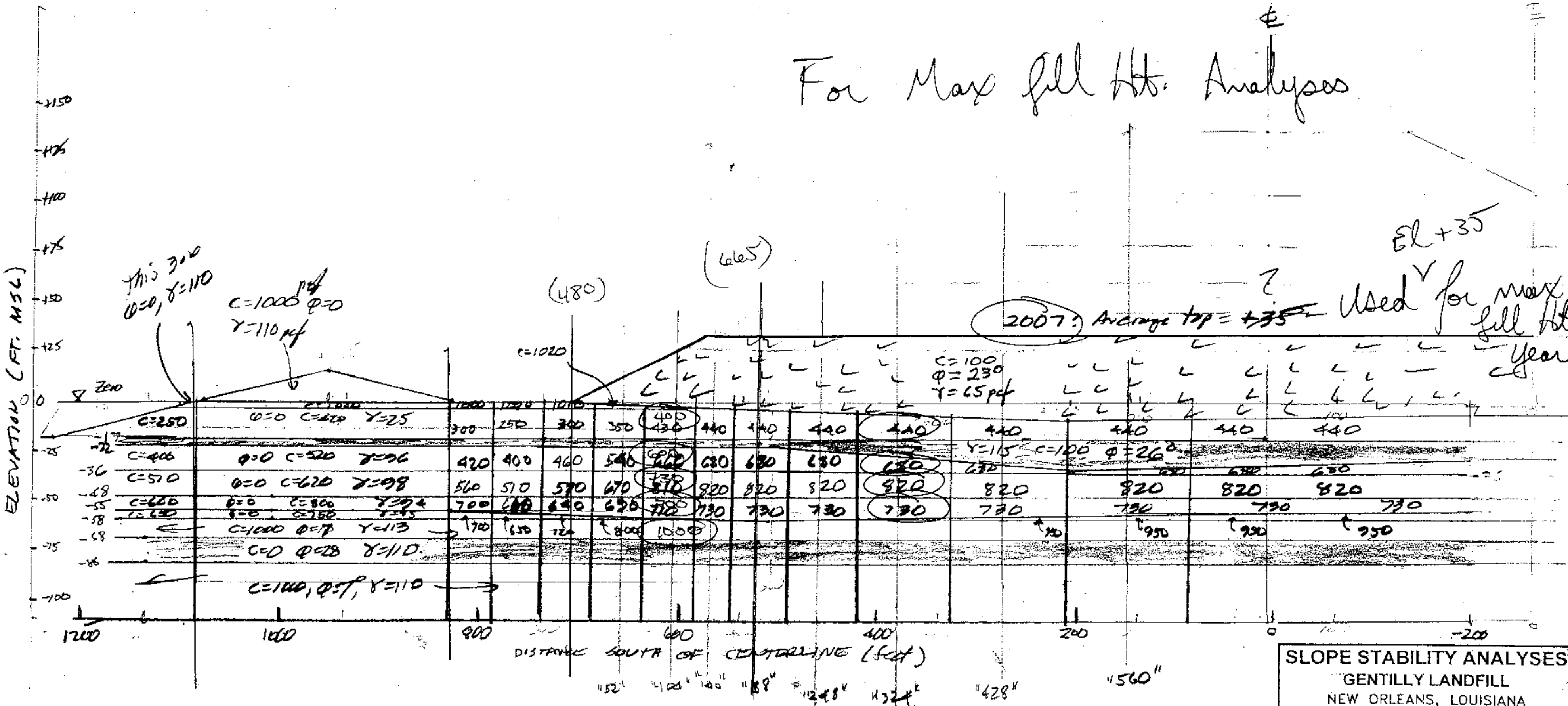

Note: Vertical Exaggeration 2X

SLOPE STABILITY ANALYSES
GENTILLY LANDFILL
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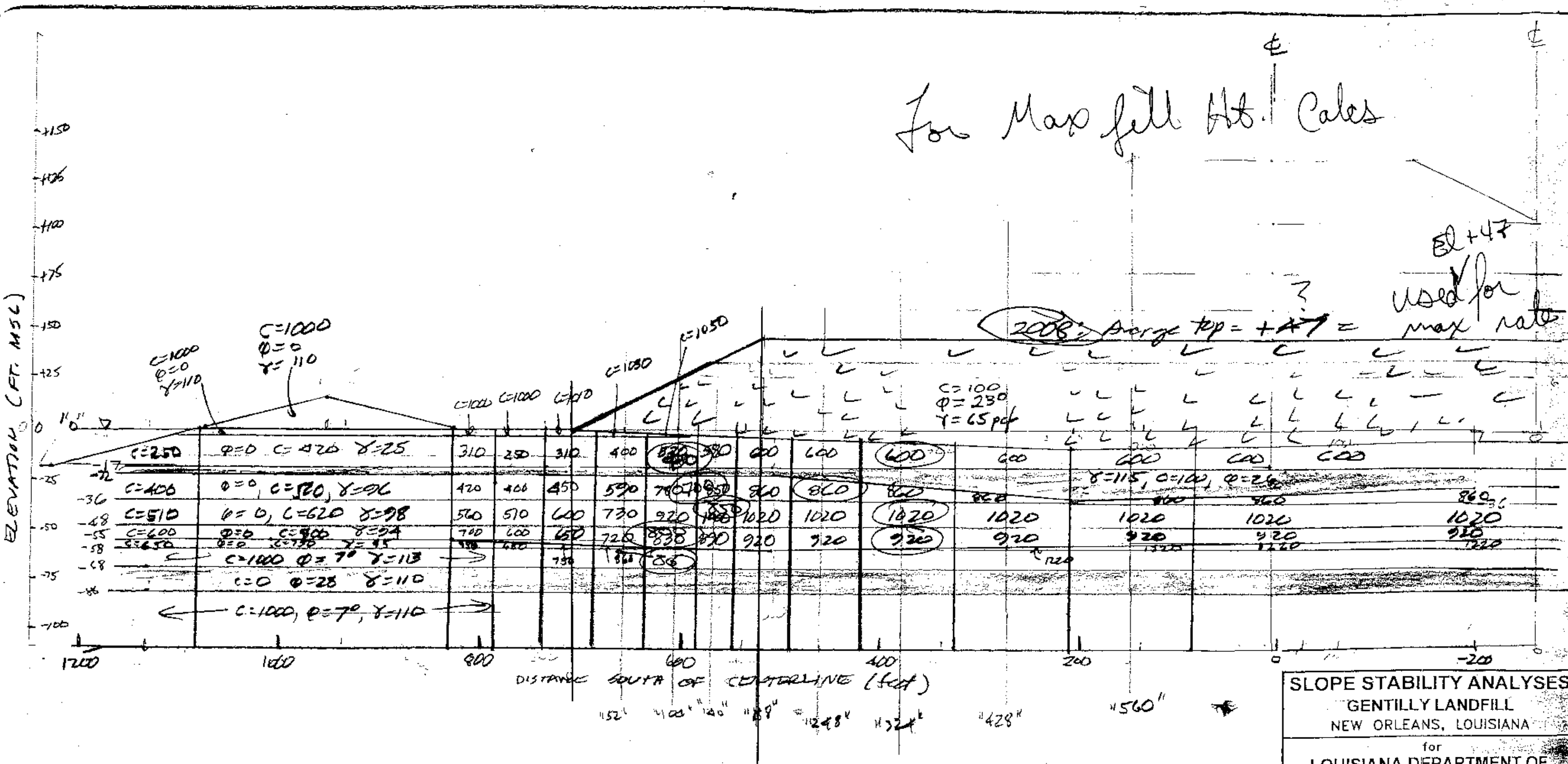
File No.: 06-1046	Date: 6-17-06	Figure No.:

Title: STABILITY ANALYSES NS-02 :



Note: Vertical Exaggeration 2X

SLOPE STABILITY ANALYSES
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File No.: 06-1046	Date: 6-17-06	Figure No.

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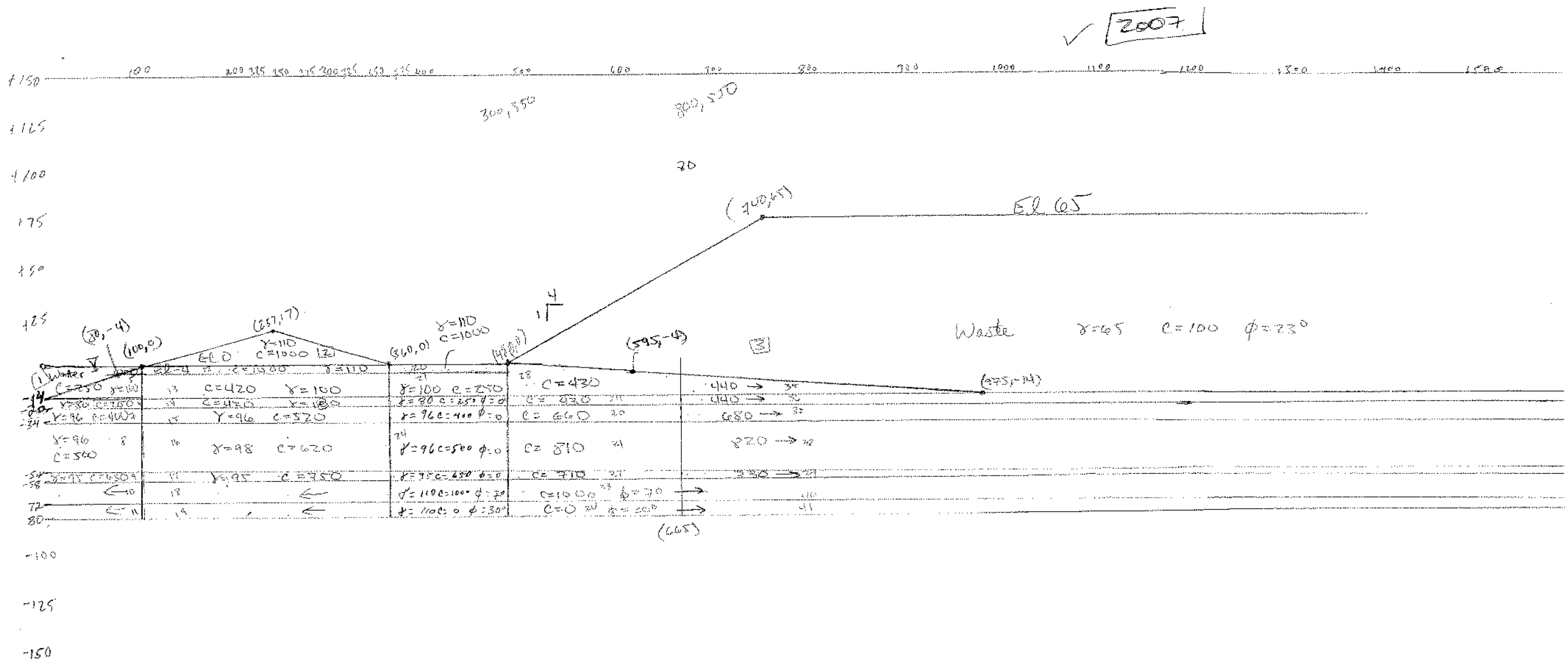


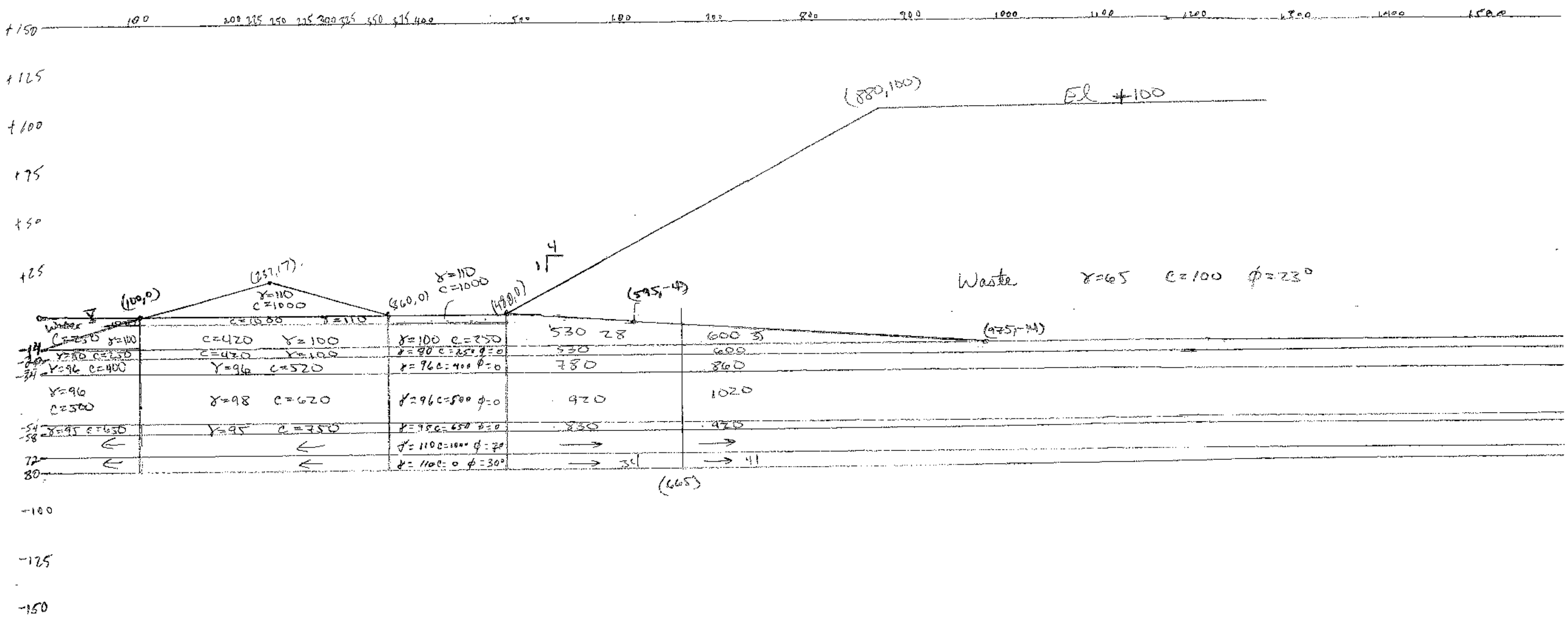
2007
Max. ht. + loading

Used Su/p = 0.28

Boring L-1 Conditions

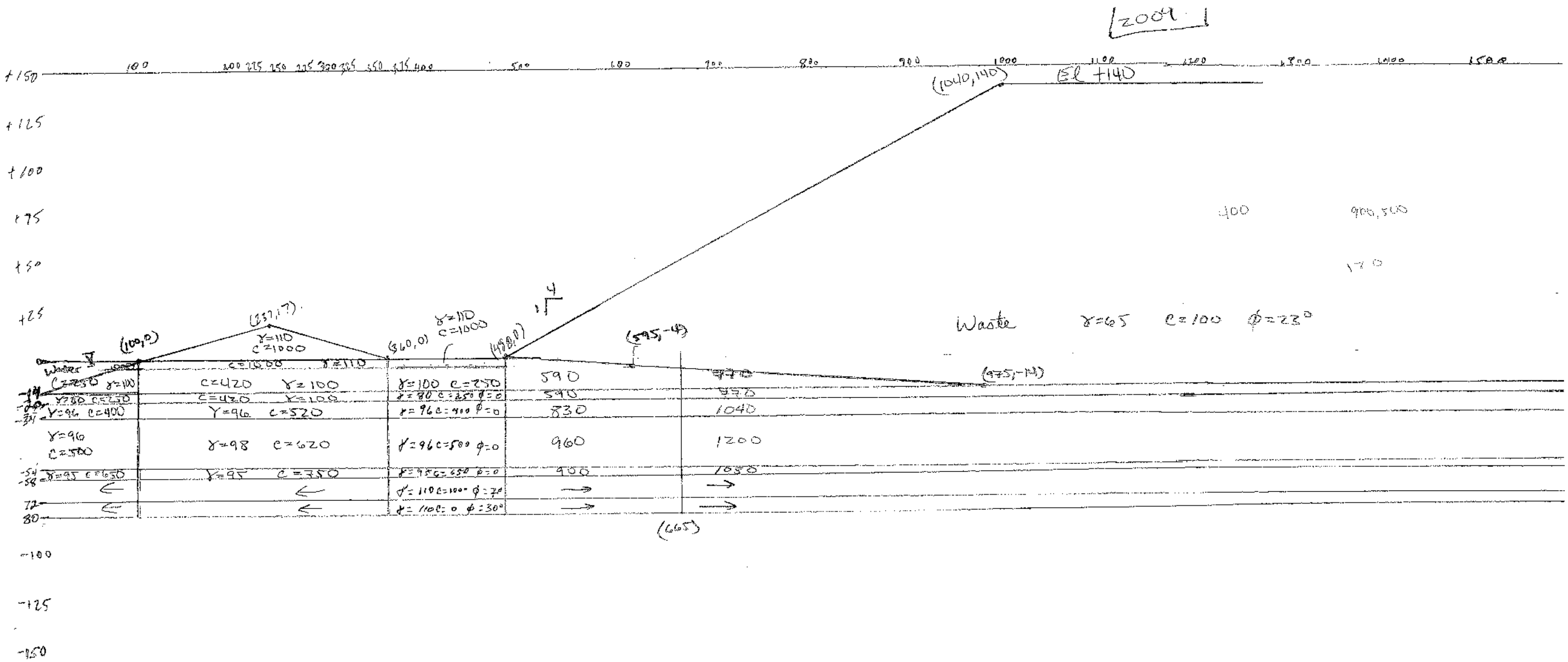
06-1046
Gentilly LF

2008 1



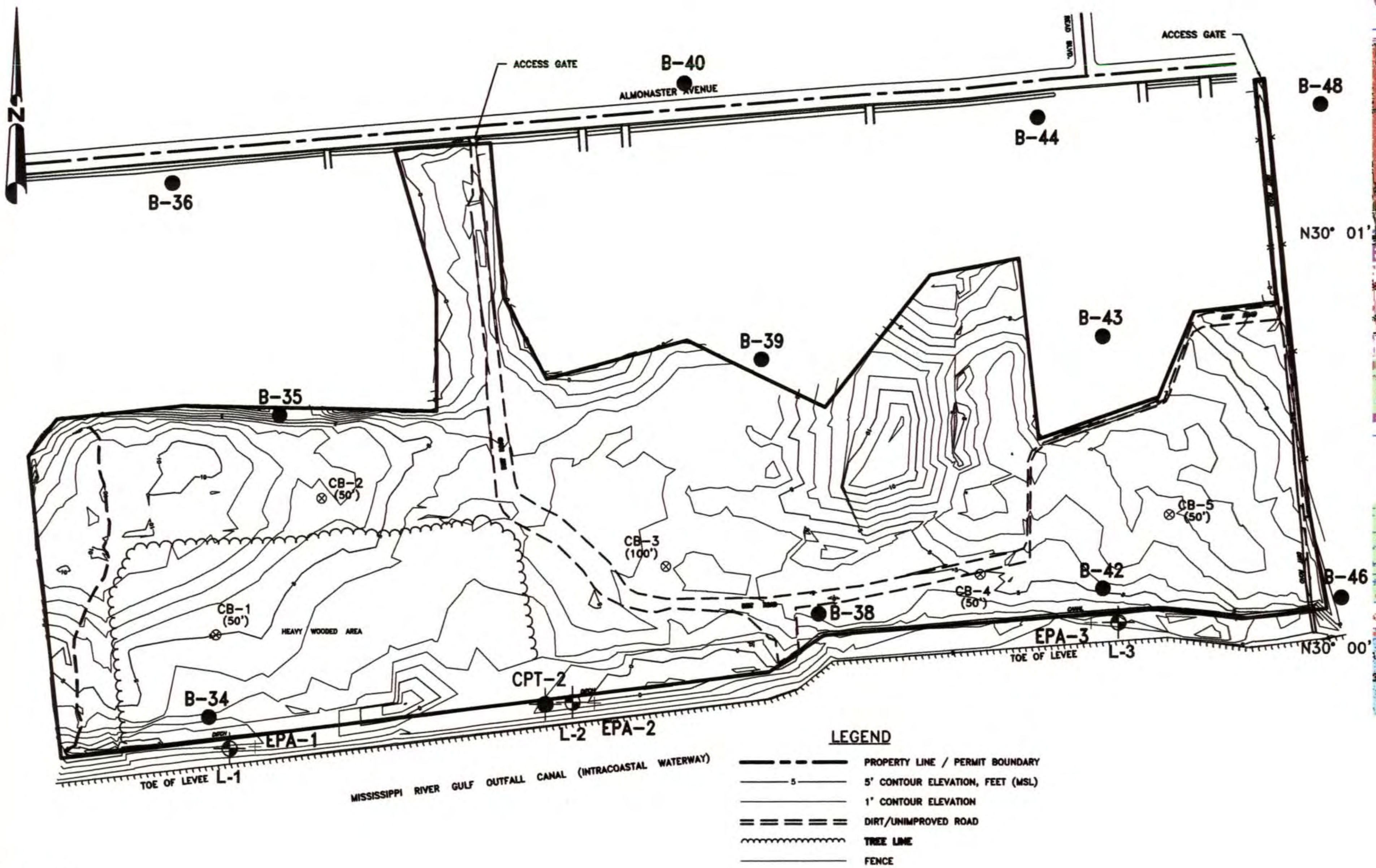
2008
Max. Ht + Loading
used Su/p = 0.28
Boring L-1 Conditions

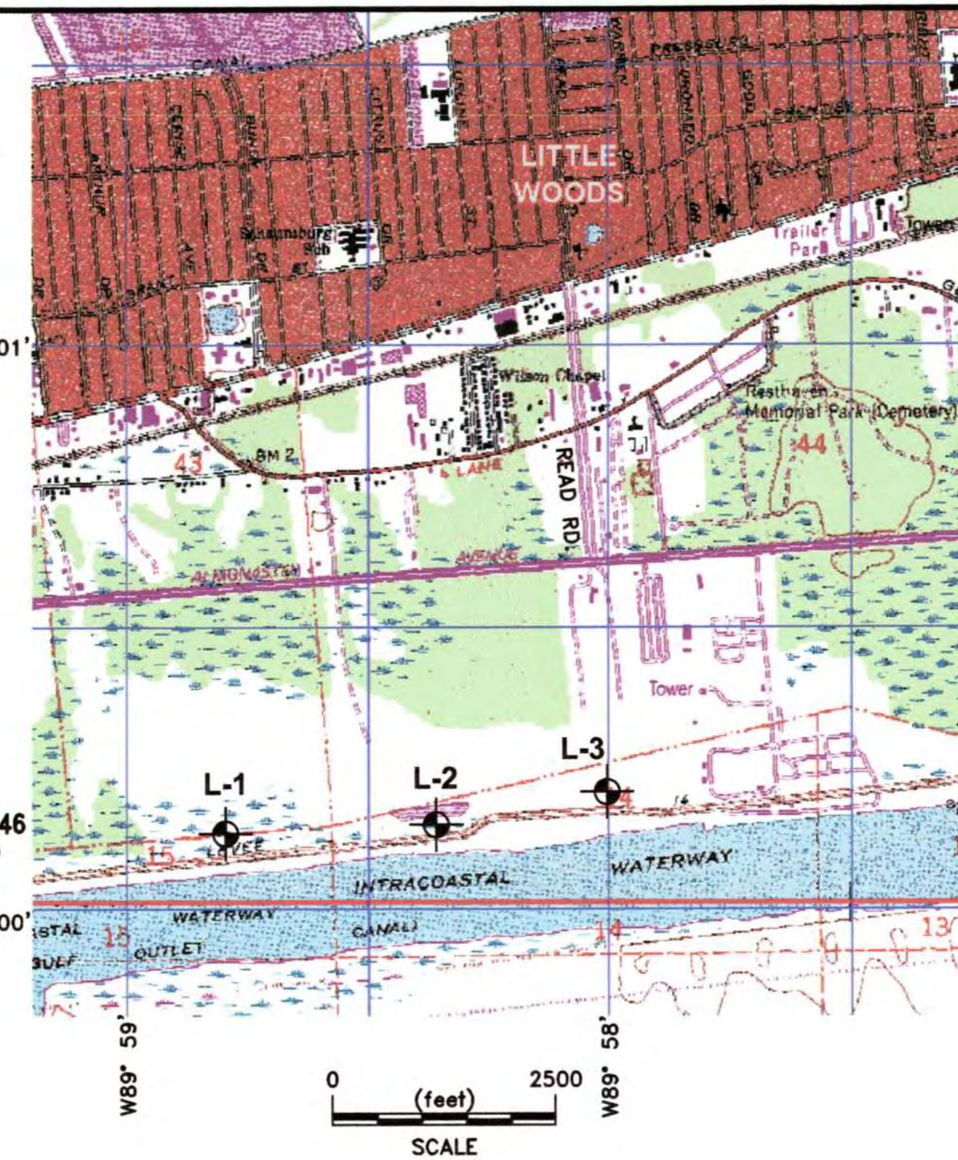
06-1046
Gentilly LF



2009
Max. ht + loading
Su/p = 0.28
Boring L-1 Conditions

06-1046
Gentilly LF





NOTE:
Boring locations are approximate.

0 (feet) 1000
SCALE

BORING DESIGNATIONS	
SYMBOL	DESCRIPTION
●	EUSTIS BORING 1982
⊗	METROPLEX BORING 2002
⊕	STE BORING 2006
● (with cross)	STE ECPT 2006
+	EPA ECPT 2006

REFERENCE:
Boring Plan by Metroplex Industries, Inc., dated 08/2002.
Boring Plan by Eustis Engineering Co. dated March, 1982.
USGS Quadrangle Map of Little Woods, LA, 1994 edition.

SLOPE STABILITY ANALYSES
GENTILLY LANDFILL
NEW ORLEANS, LOUISIANA

for

LOUISIANA DEPARTMENT OF ENVIRONMENTAL QUALITY
OFFICE OF ENVIRONMENTAL SERVICES
BATON ROUGE, LOUISIANA

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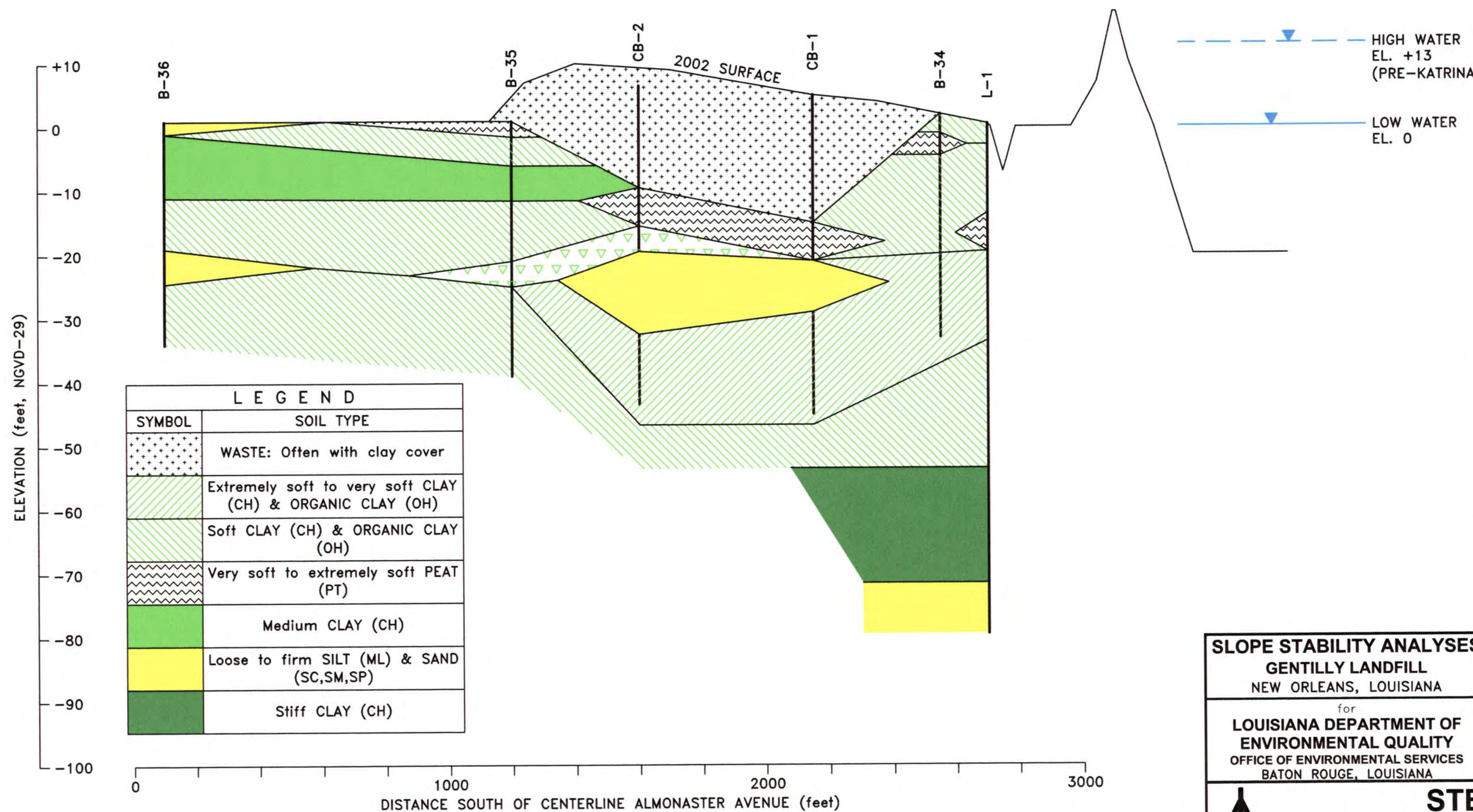
Project Engineer:	Drawn by:	Checked by:
G.P. Boutwell	DMS	
File No.:	Date:	Figure No.:
06-1046	6-16-06	1

Title: **BORING PLAN**



SOURCES:
Borings & locations: EECO 1982, Metroplex 2004.

Levee sections: USACE fax 16 Feb 06.

SLOPE STABILITY ANALYSES
GENTILLY LANDFILL
NEW ORLEANS, LOUISIANA

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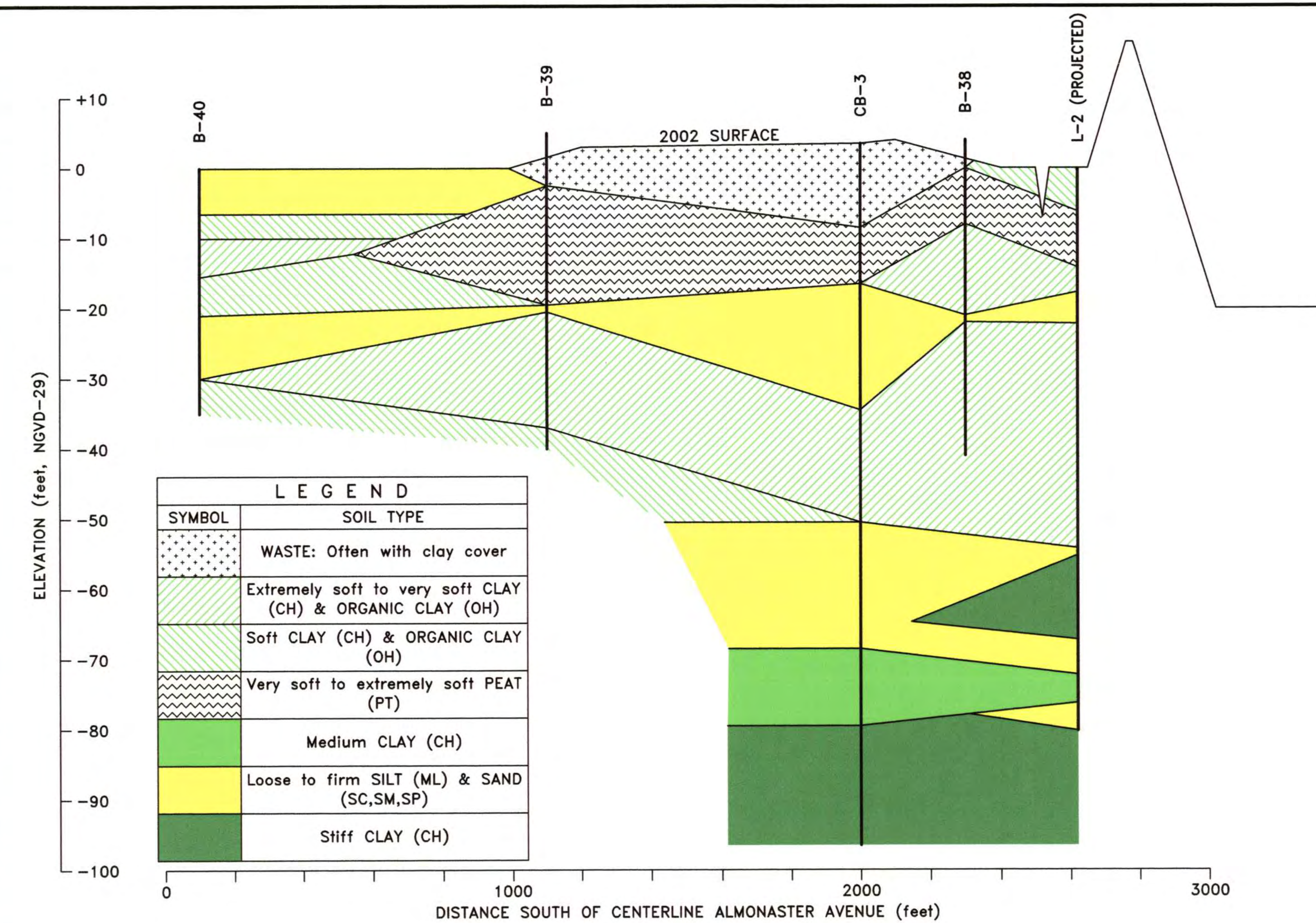
STE
Soil Testing Engineers, Inc.
Baton Rouge, LA Jefferson, LA Biloxi, MS

Project Engineer: G.P. Boutwell	Drawn by: DMS	Checked by:
File No.: 06-1046	Date: 6-16-06	Figure No.: 2

Title: **SOIL PROFILE NS-01**
4800' W OF READ ROAD



SOURCES:
Borings & locations: EECO 1982, Metroplex 2004.

Levee sections: USACE fax 16 Feb 06.

SLOPE STABILITY ANALYSES
GENTILLY LANDFILL
NEW ORLEANS, LOUISIANA

for

LOUISIANA DEPARTMENT OF ENVIRONMENTAL QUALITY
OFFICE OF ENVIRONMENTAL SERVICES
BATON ROUGE, LOUISIANA

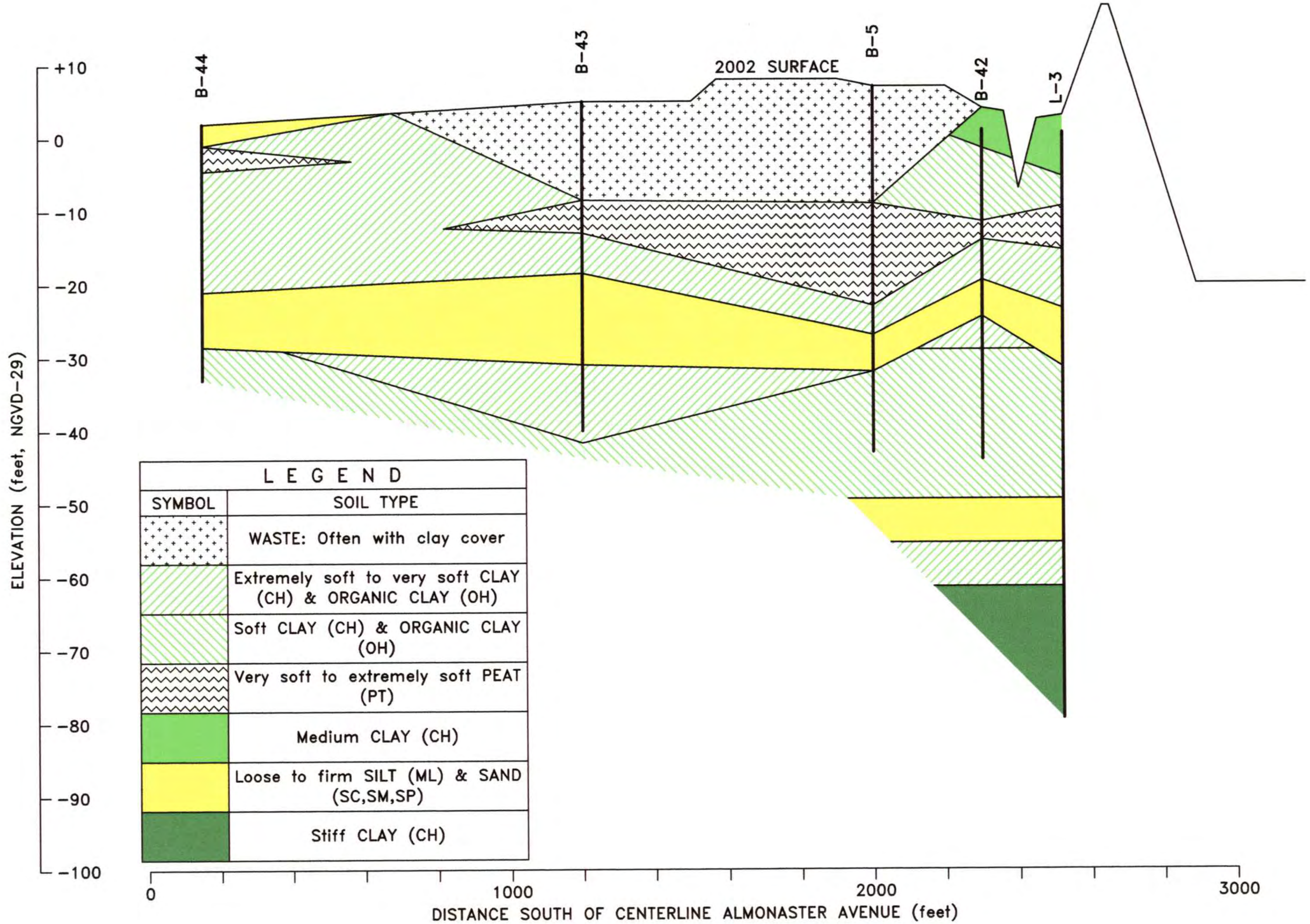
STE
Soil Testing Engineers, Inc.
Baton Rouge, LA Jefferson, LA Biloxi, MS

Project Engineer: G.P. Boutwell	Drawn by: DMS	Checked by:
File No.: 06-1046	Date: 6-16-06	Figure No.: 3

Title: **SOIL PROFILE NS-02**
1700' W OF READ ROAD

P:\2006\06-1046 Gentilly LF\CADD\061046-04 XSECT NS-03.dwg

Jul 25, 2006 - 9:20am



SOURCES:
Borings & locations: EECO 1982, Metroplex 2004.

Levee sections: USACE fax 16 Feb 06.

SLOPE STABILITY ANALYSES
GENTILLY LANDFILL
NEW ORLEANS, LOUISIANA

for

LOUISIANA DEPARTMENT OF ENVIRONMENTAL QUALITY
OFFICE OF ENVIRONMENTAL SERVICES
BATON ROUGE, LOUISIANA

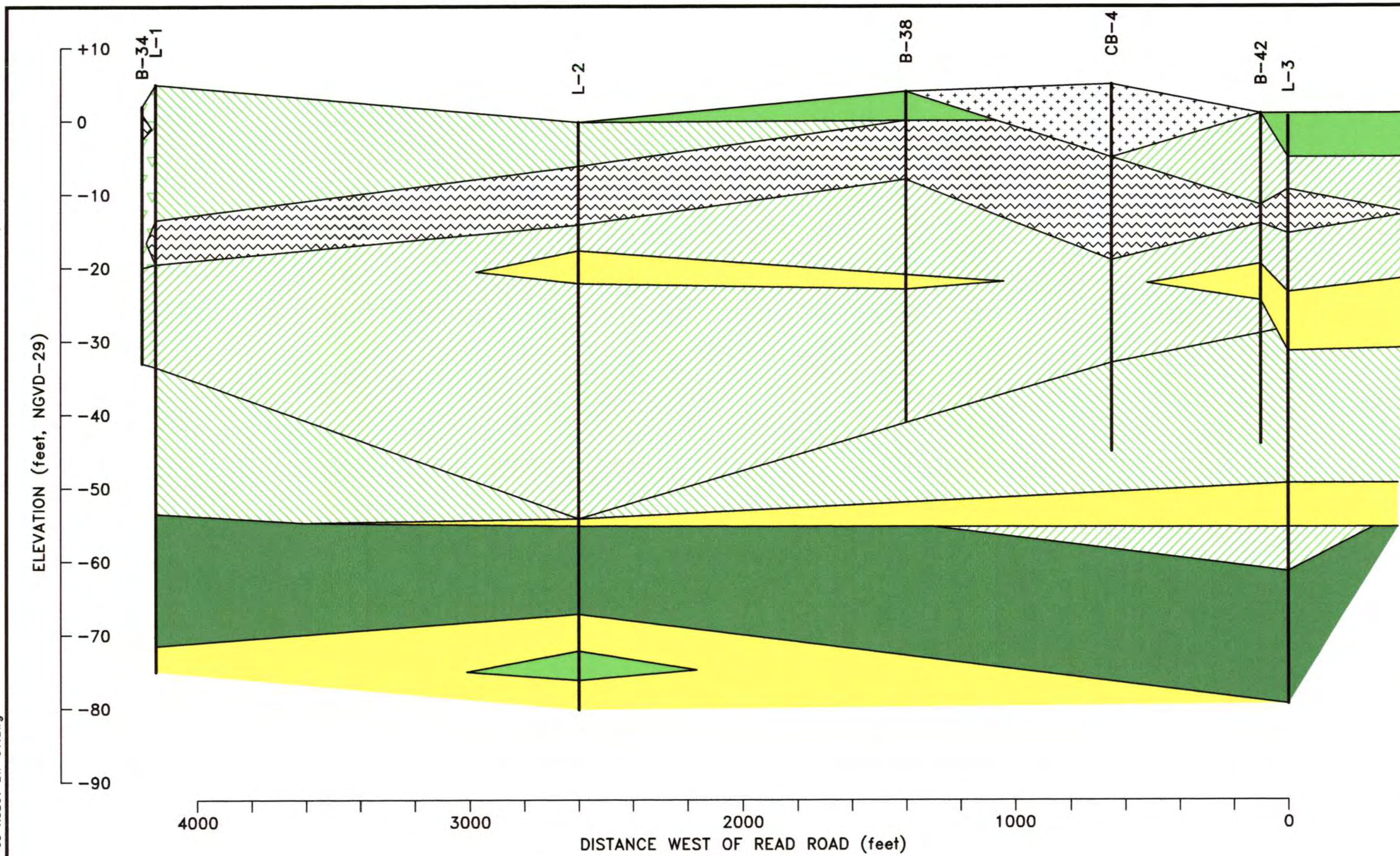
STE
Soil Testing Engineers, Inc.
Baton Rouge, LA Jefferson, LA Biloxi, MS

Project Engineer: G.P. Boutwell	Drawn by: DMS	Checked by:
File No.: 06-1046	Date: 6-16-06	Figure No.: 4

Title: **SOIL PROFILE NS-03**
0' W OF READ ROAD

P:\2006\06-1046 Gentilly LF\CADD\061046-05 XSECT EW-01.dwg

Jul 25, 2006 - 9:20am



LEGEND	
SYMBOL	SOIL TYPE
	WASTE: Often with clay cover
	Extremely soft to very soft CLAY (CH) & ORGANIC CLAY (OH)
	Soft CLAY (CH) & ORGANIC CLAY (OH)
	Very soft to extremely soft PEAT (PT)
	Medium CLAY (CH)
	Loose to firm SILT (ML) & SAND (SC,SM,SP)
	Stiff CLAY (CH)

SOURCES:
Borings & locations: EECO 1982, Metroplex 2004.

Levee sections: USACE fax 16 Feb 06.

SLOPE STABILITY ANALYSES
GENTILLY LANDFILL
NEW ORLEANS, LOUISIANA

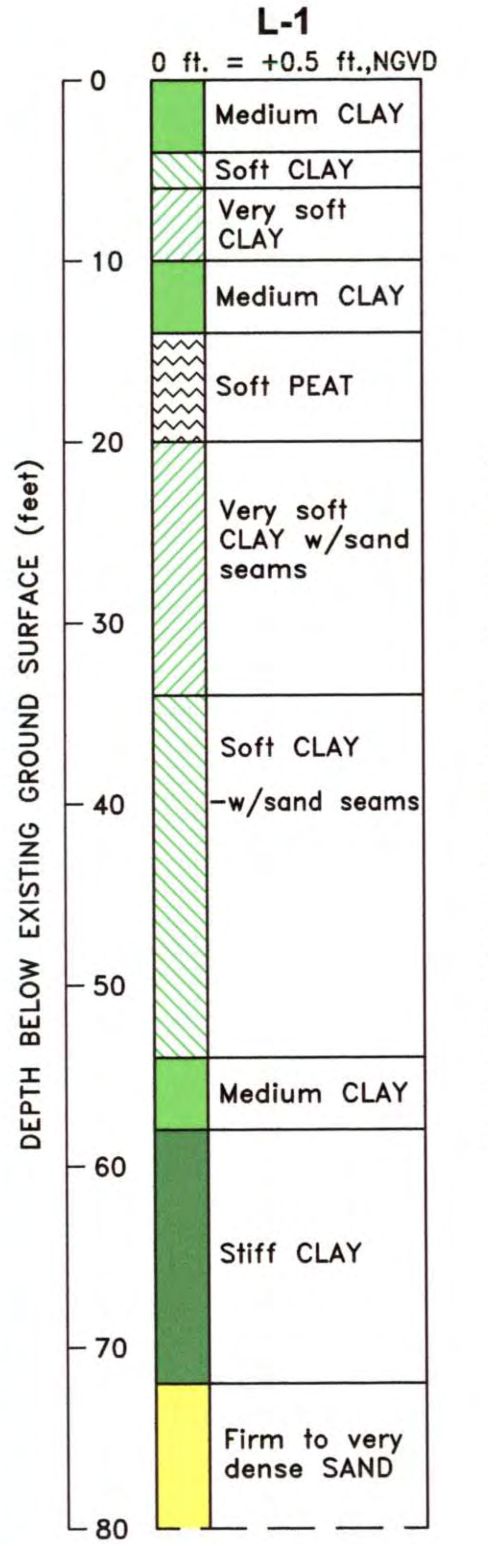
for

LOUISIANA DEPARTMENT OF ENVIRONMENTAL QUALITY
OFFICE OF ENVIRONMENTAL SERVICES
BATON ROUGE, LOUISIANA

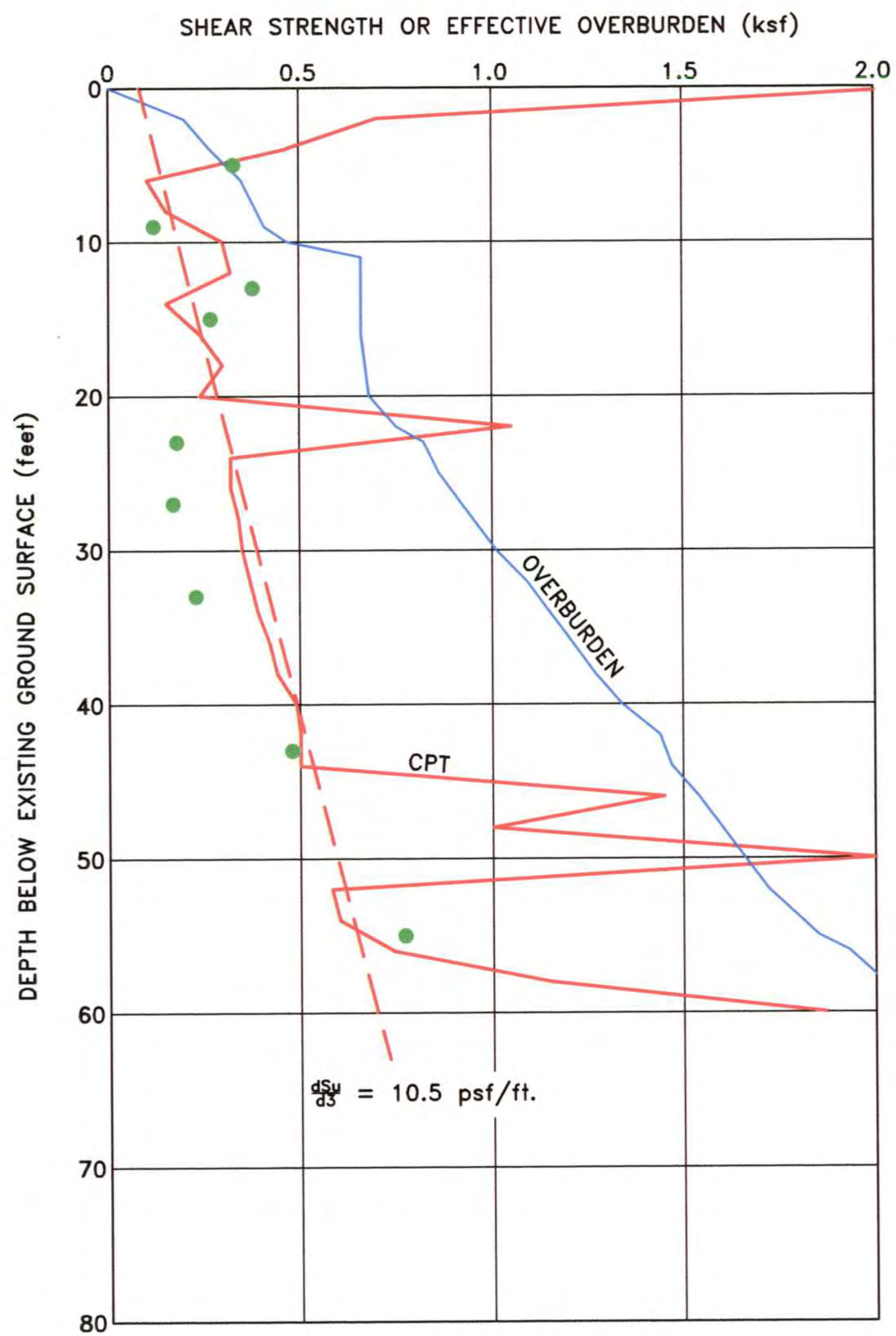
STE
Soil Testing Engineers, Inc.
Baton Rouge, LA Jefferson, LA Biloxi, MS

Project Engineer: G.P. Boutwell	Drawn by: DMS	Checked by:
File No.: 06-1046	Date: 6-16-06	Figure No.: 5

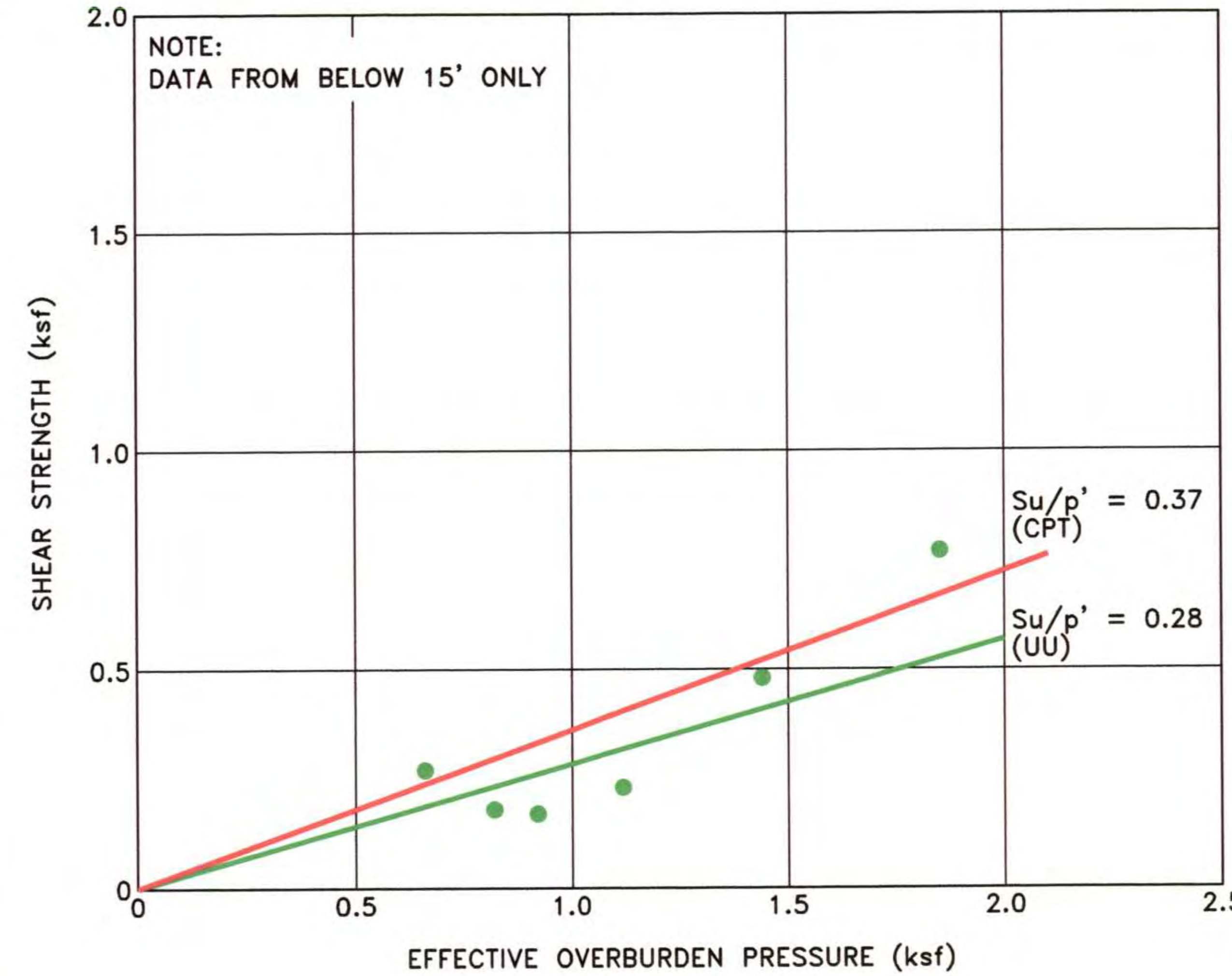
Title: **SOIL PROFILE EW-01 ALONG CANAL SIDE**



SOIL TYPES



SOIL STRENGTH PROFILE



LEGEND	
SYMBOL	DESCRIPTION
red line	SHEAR STRENGTH BY CPT
green dot	SHEAR STRENGTH BY UU TRIAXIAL
yellow square	SHEAR STRENGTH BY DIRECT SIMPLE SHEAR
blue line	EFFECTIVE OVERBURDEN

NOTE:
CPT and DSS data furnished by USEPA.

SLOPE STABILITY ANALYSES
GENTILLY LANDFILL
NEW ORLEANS, LOUISIANA

for

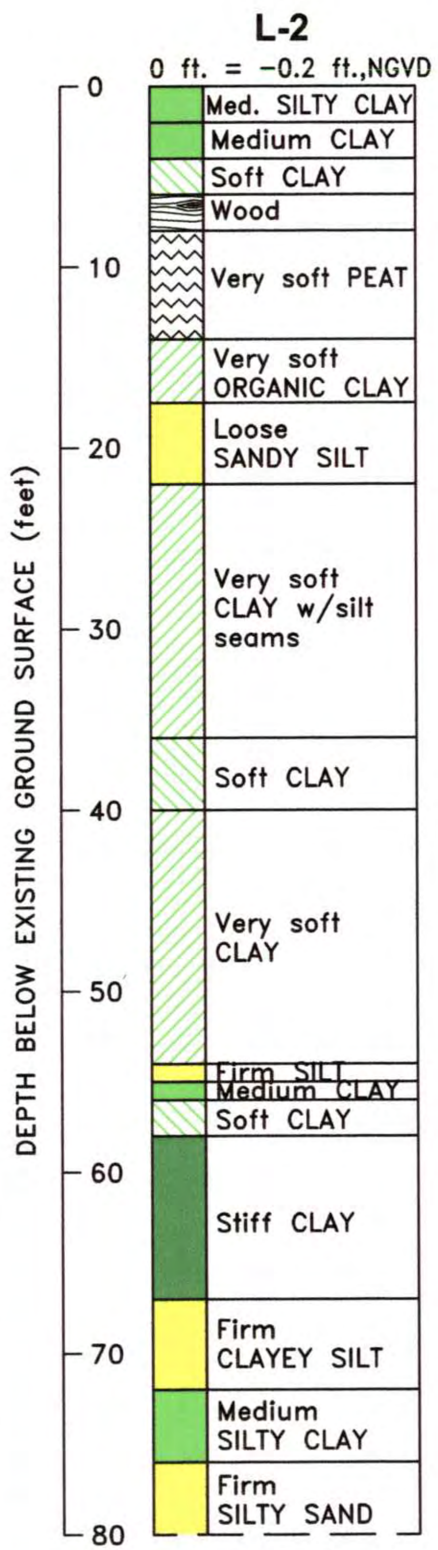
LOUISIANA DEPARTMENT OF ENVIRONMENTAL QUALITY
OFFICE OF ENVIRONMENTAL SERVICES
BATON ROUGE, LOUISIANA

STE
Soil Testing Engineers, Inc.
Baton Rouge, LA Jefferson, LA Biloxi, MS

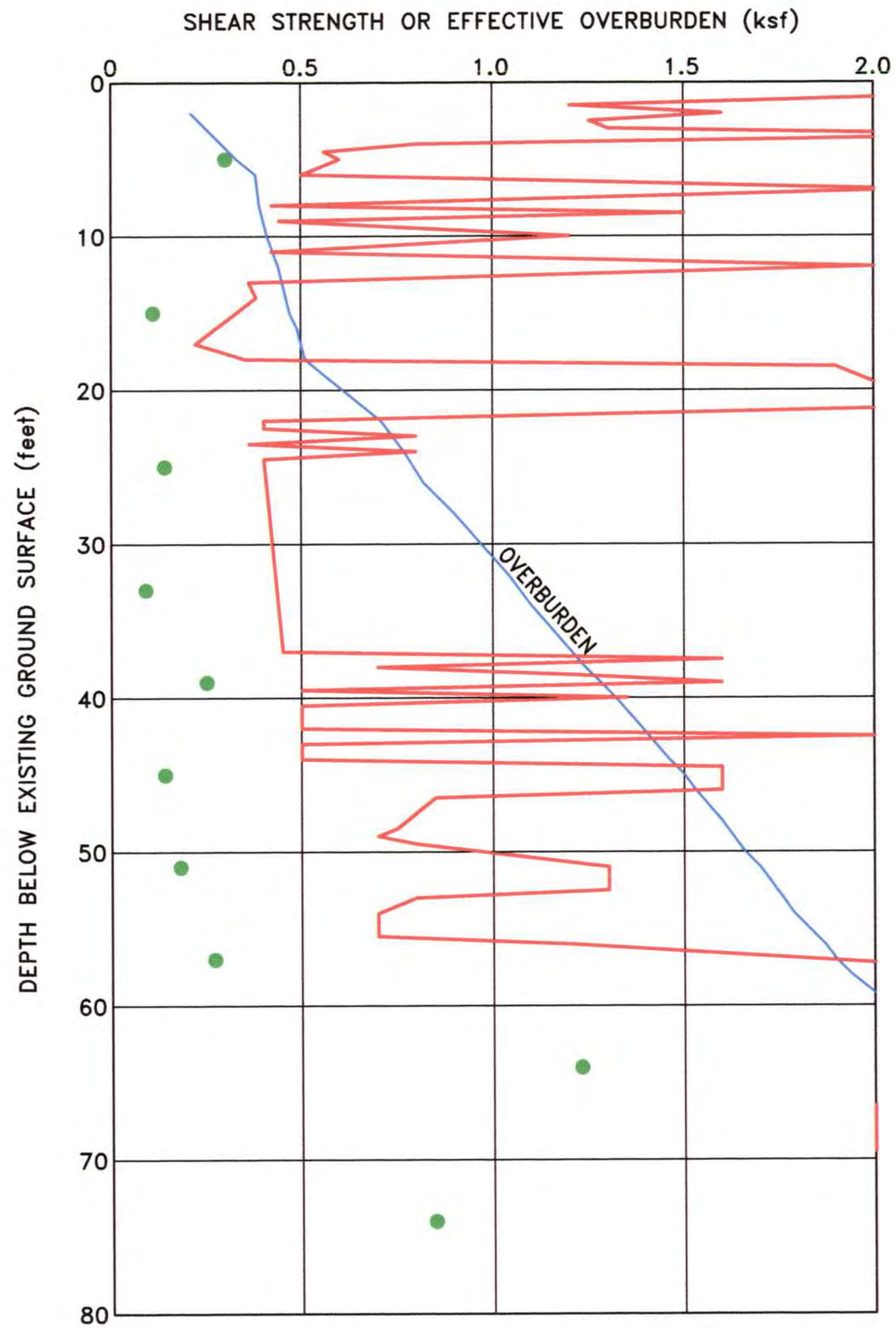
Project Engineer: G.P. Boutwell	Drawn by: DMS	Checked by:
File No.: 06-1046	Date: 6-17-06	Figure No.: 6

Title: **STRENGTH DATA BORING L-1**

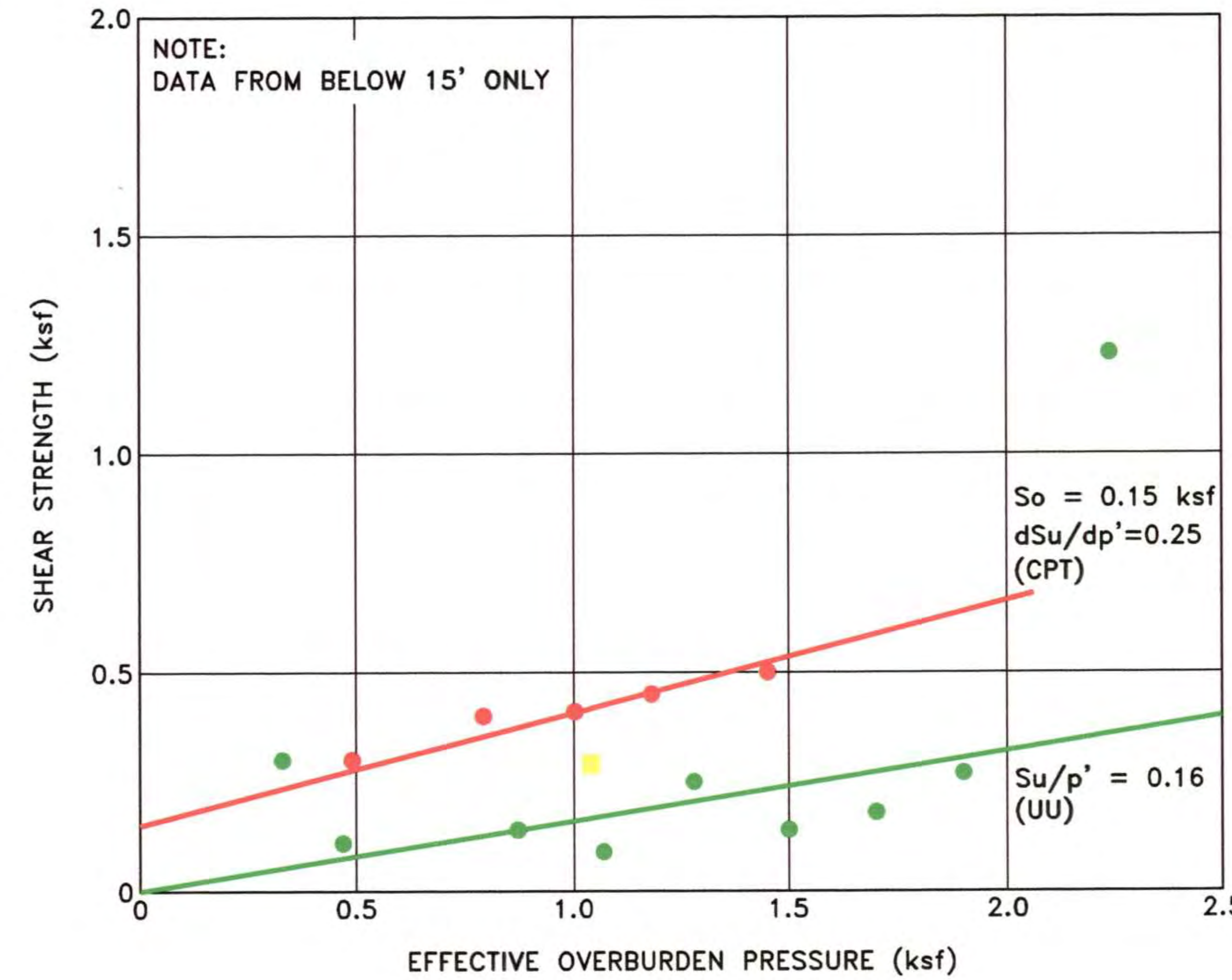
P:\2006\06-1046 Gentilly LF\CADD\061046-07 Strength L-2.dwg   Jul 25, 2006 - 9:21am



SOIL TYPES



SOIL STRENGTH PROFILE



NOTE:
DSS data furnished by USEPA.

L E G E N D

SYMBOL	DESCRIPTION
(red line)	SHEAR STRENGTH BY CPT
(green dot)	SHEAR STRENGTH BY UU TRIAXIAL
(yellow square)	SHEAR STRENGTH BY DIRECT SIMPLE SHEAR
(blue line)	EFFECTIVE OVERBURDEN

SLOPE STABILITY ANALYSES
GENTILLY LANDFILL
NEW ORLEANS, LOUISIANA

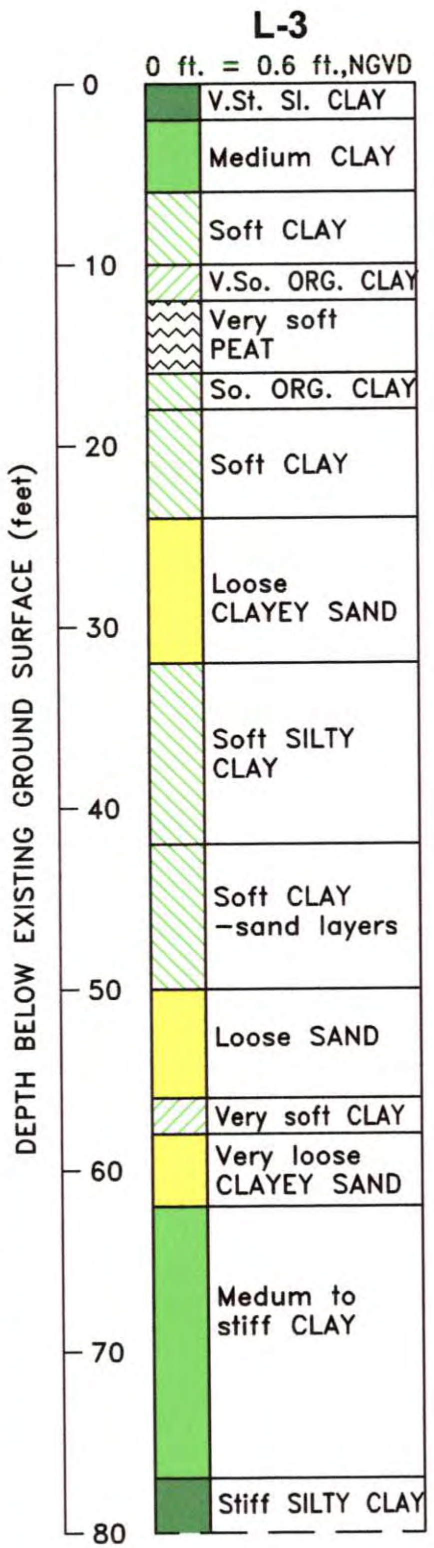
for

LOUISIANA DEPARTMENT OF ENVIRONMENTAL QUALITY
OFFICE OF ENVIRONMENTAL SERVICES
BATON ROUGE, LOUISIANA

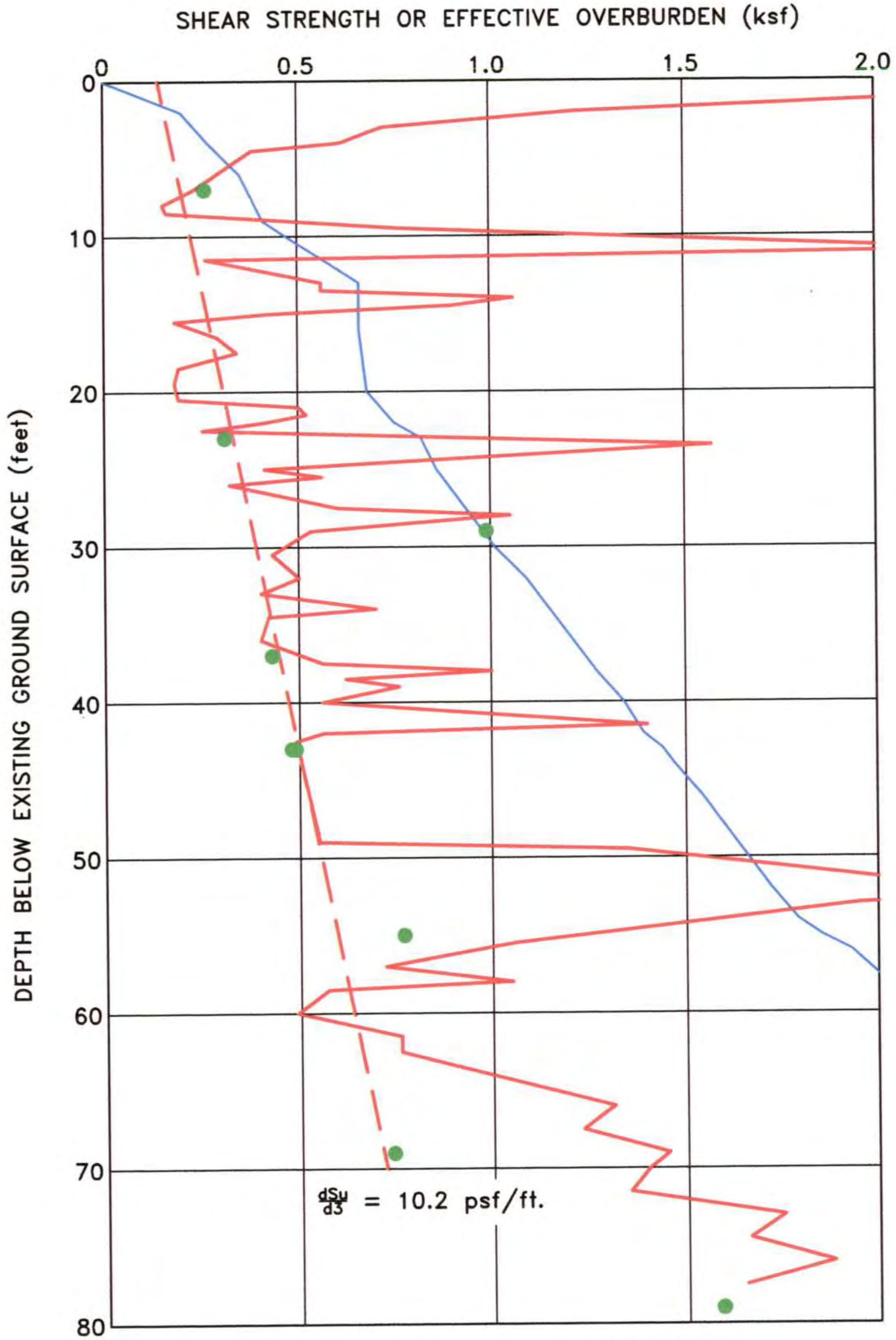
STE Soil Testing Engineers, Inc.
Baton Rouge, LA   Jefferson, LA   Biloxi, MS

Project Engineer: G.P. Boutwell	Drawn by: DMS	Checked by: CM
File No.: 06-1046	Date: 6-17-06	Figure No.: 7

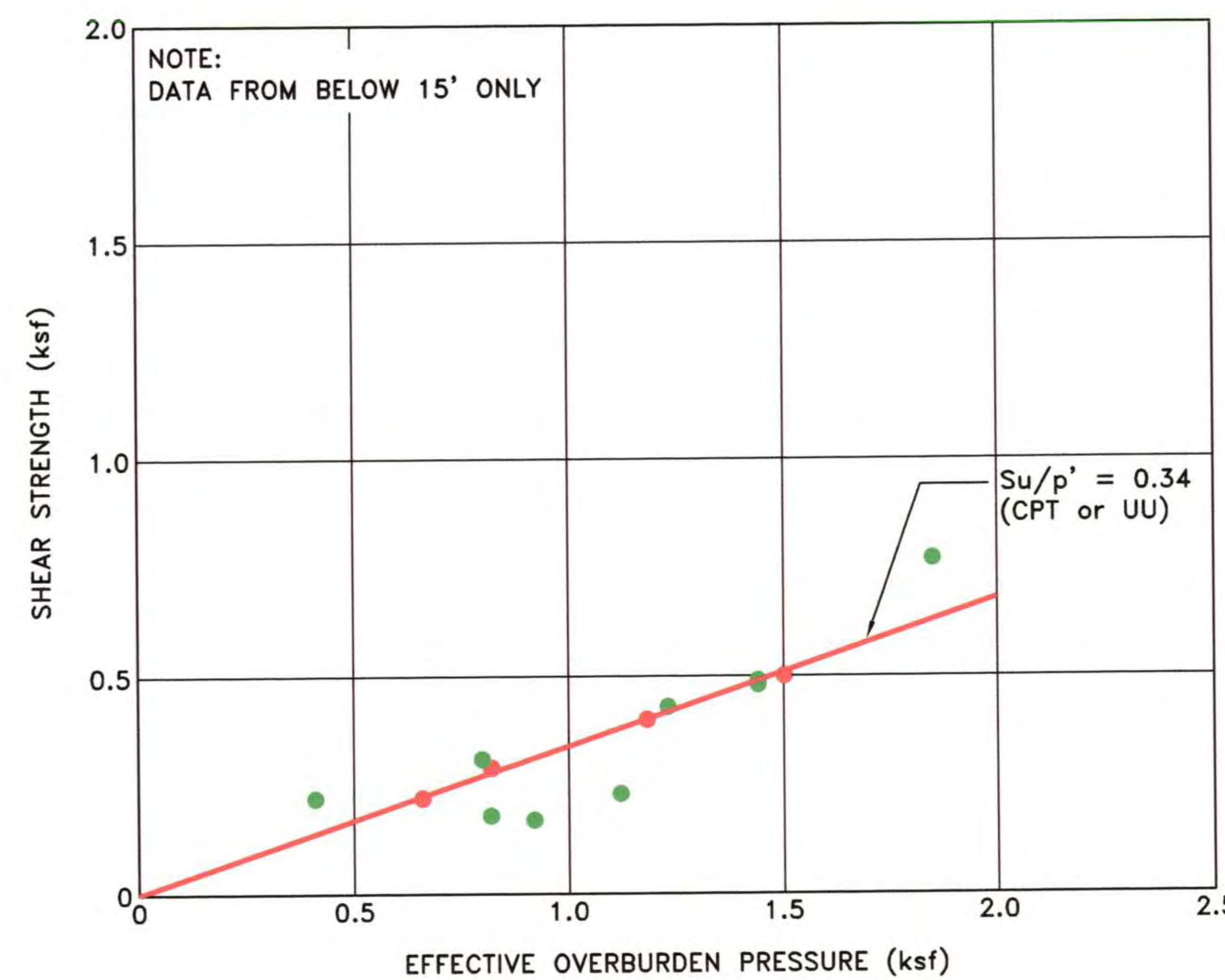
Title: **STRENGTH DATA BORING L-2**



SOIL TYPES



SOIL STRENGTH PROFILE



L E G E N D

SYMBOL	DESCRIPTION
red line	SHEAR STRENGTH BY CPT
green dot	SHEAR STRENGTH BY UU TRIAXIAL
yellow square	SHEAR STRENGTH BY DIRECT SIMPLE SHEAR
blue line	EFFECTIVE OVERBURDEN

NOTE:
CPT and DSS data furnished by USEPA.

SLOPE STABILITY ANALYSES
GENTILLY LANDFILL
NEW ORLEANS, LOUISIANA

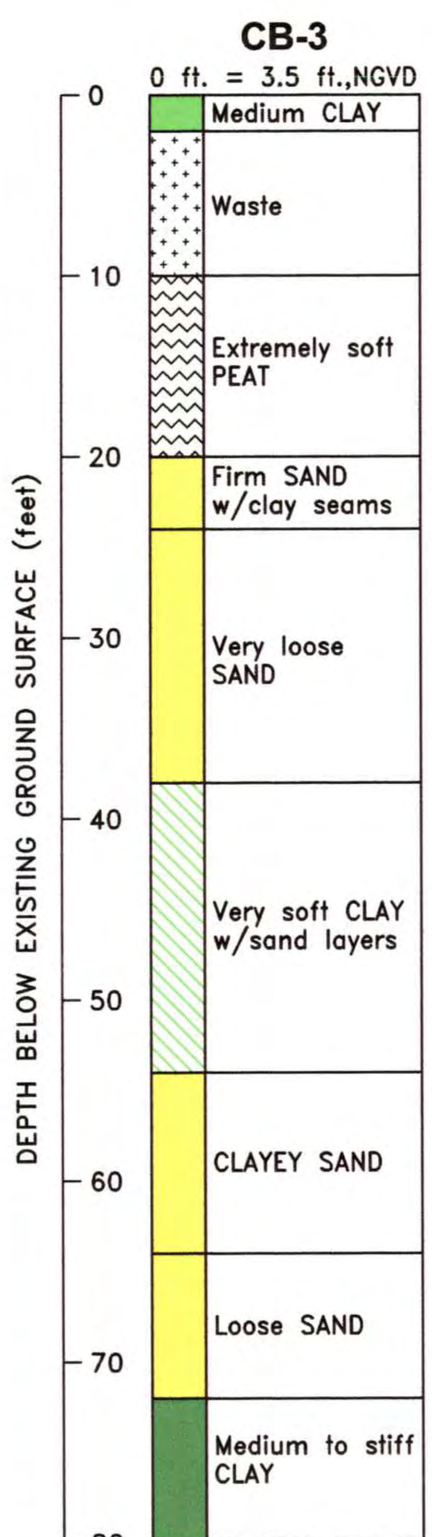
for

LOUISIANA DEPARTMENT OF ENVIRONMENTAL QUALITY
OFFICE OF ENVIRONMENTAL SERVICES
BATON ROUGE, LOUISIANA

STE
Soil Testing Engineers, Inc.
Baton Rouge, LA Jefferson, LA Biloxi, MS

Project Engineer: G.P. Boutwell	Drawn by: DMS	Checked by:
File No.: 06-1046	Date: 6-17-06	Figure No.: 8

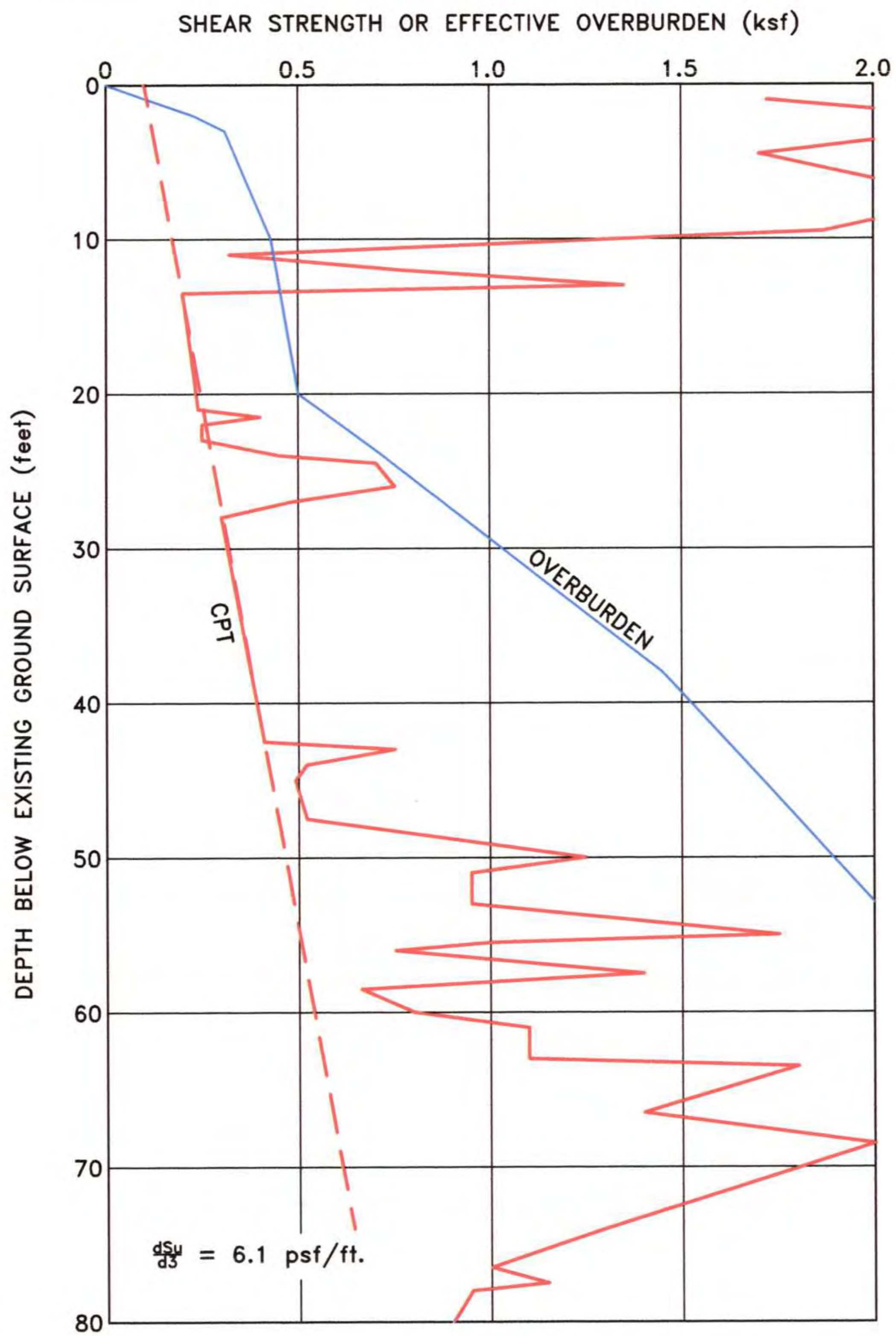
Title: **STRENGTH DATA BORING L-3**



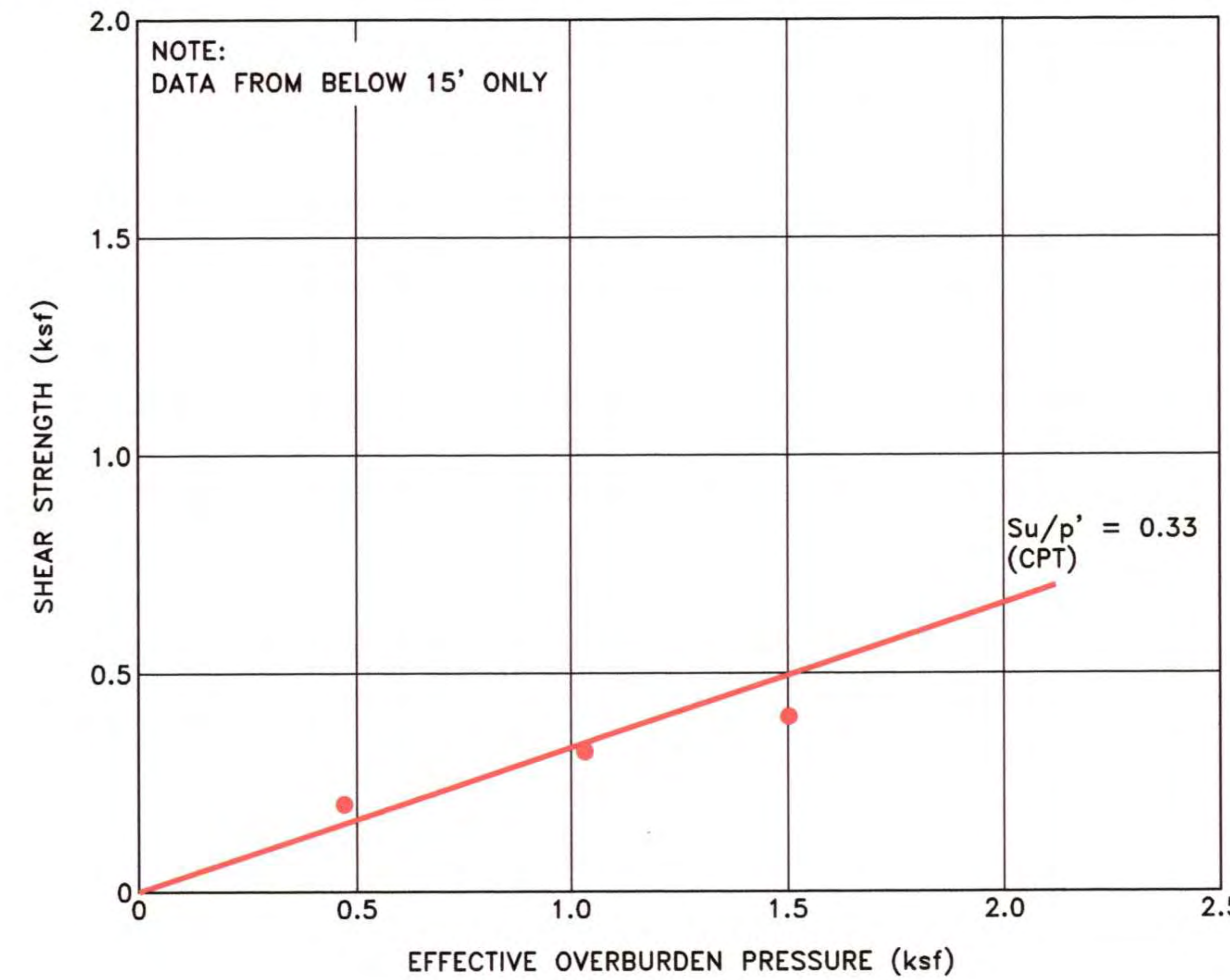
SOIL TYPES

(N): Std. Penetration Resistance (b/f)

NOTE:
CPT data furnished by USEPA.
Boring furnished by Metroplex.



SOIL STRENGTH PROFILE



L E G E N D	
SYMBOL	DESCRIPTION
red line	SHEAR STRENGTH BY CPT
green dot	SHEAR STRENGTH BY UU TRIAXIAL
yellow square	SHEAR STRENGTH BY DIRECT SIMPLE SHEAR
blue line	EFFECTIVE OVERBURDEN

SLOPE STABILITY ANALYSES
GENTILLY LANDFILL
NEW ORLEANS, LOUISIANA

for

LOUISIANA DEPARTMENT OF ENVIRONMENTAL QUALITY
OFFICE OF ENVIRONMENTAL SERVICES
BATON ROUGE, LOUISIANA

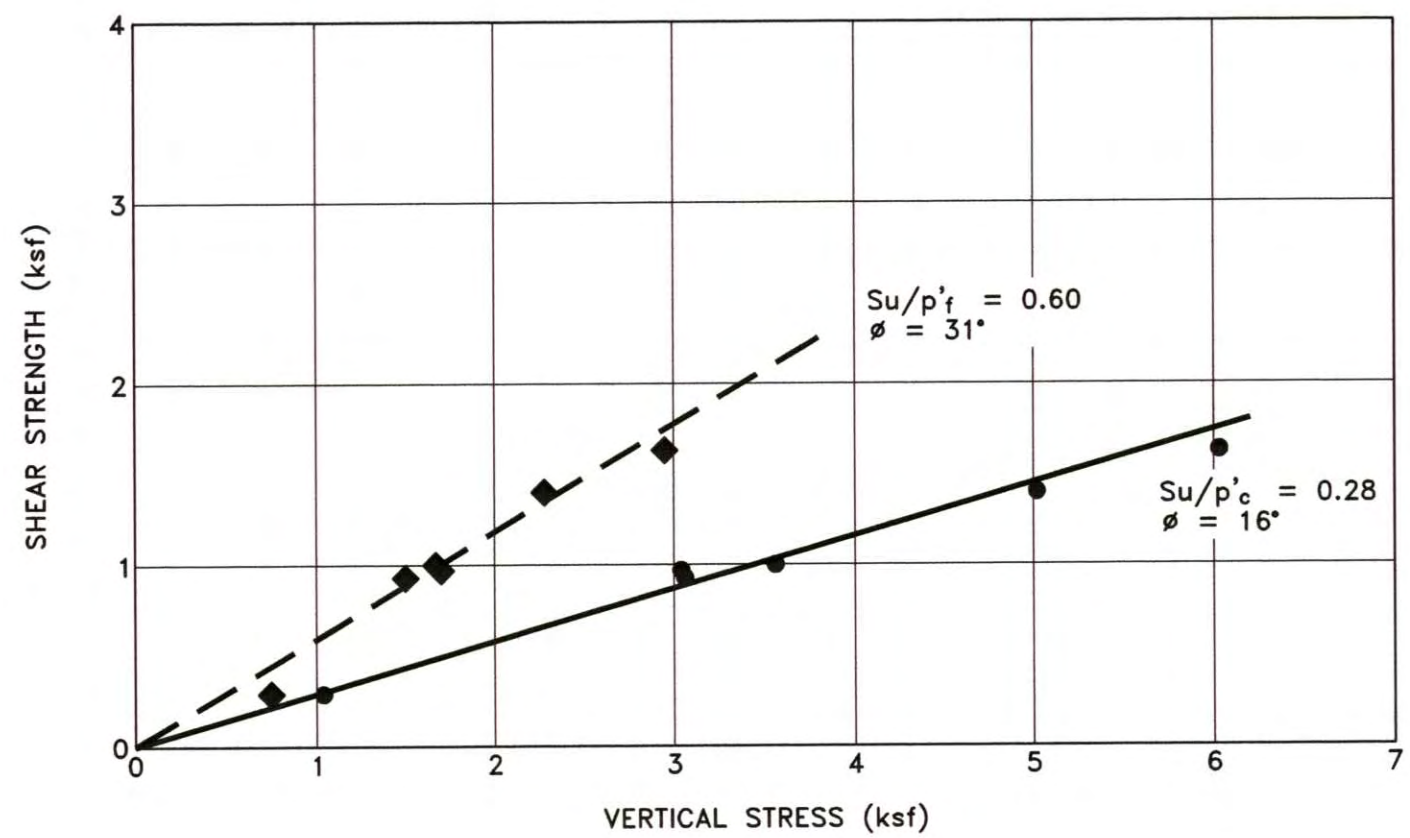
STE
Soil Testing Engineers, Inc.
Baton Rouge, LA Jefferson, LA Biloxi, MS

Project Engineer: G.P. Boutwell	Drawn by: DMS	Checked by:
File No.: 06-1046	Date: 6-21-06	Figure No.: 9

Title: **STRENGTH DATA BORING CB-3**

P:\2006\06-1046 Gentilly LF\CADD\061046-10 Direct Shear.dwg

Jul 25, 2006 - 9:23am



BORING NO.	DEPTH (feet)	WATER CONTENT (%)	DRY DENSITY (pcf)	LIQUID LIMIT (%)	VERTICAL EFFECTIVE STRESS (ksf)		SHEAR STRENGTH (ksf)
					CONSOLIDATION	AT FAILURE	
L-1	13.8	180	27	224	1.04	0.75	0.29
L-2	27.8	53	69	54	3.56	1.67	1.00
L-2	47.7	79	52	95	3.04	1.70	0.97
L-3	13.5	64	61	73	3.06	1.50	0.93
L-3	21.8	55	70	57	5.02	2.28	0.40
L-3	47.7	69	57	95	6.03	2.95	1.63

NOTE: Data furnished by USEPA: Water and Density are before consolidation.

SLOPE STABILITY ANALYSES
GENTILLY LANDFILL
NEW ORLEANS, LOUISIANA

for

LOUISIANA DEPARTMENT OF ENVIRONMENTAL QUALITY
OFFICE OF ENVIRONMENTAL SERVICES
BATON ROUGE, LOUISIANA

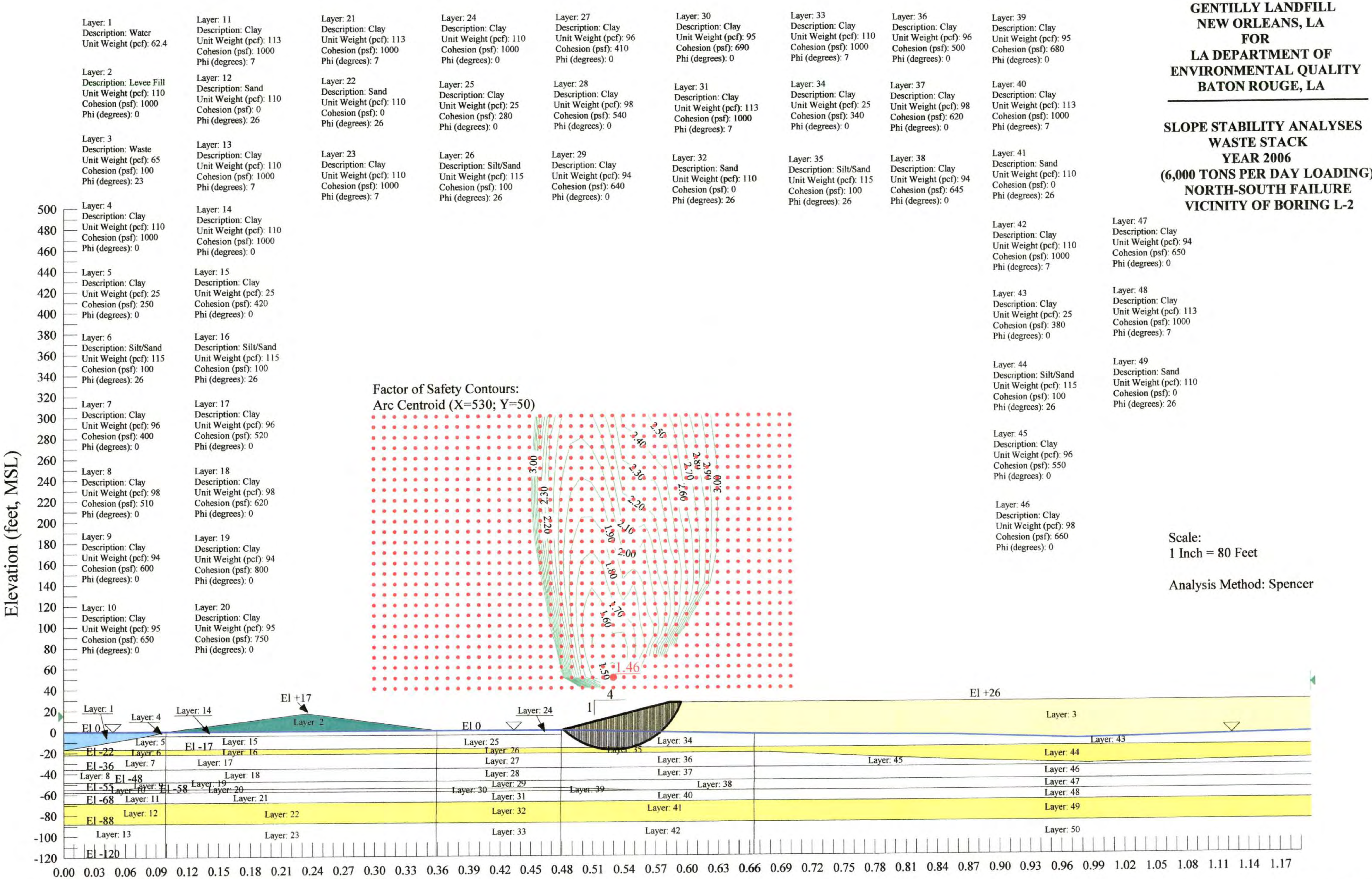
STE Soil Testing Engineers, Inc.
Baton Rouge, LA Jefferson, LA Biloxi, MS

Project Engineer: G.P. Boutwell	Drawn by: DMS	Checked by: CAH
File No.: 06-1046	Date: 6-17-06	Figure No.: 10

Title: **DIRECT SIMPLE SHEAR TESTS**

GENTILLY LANDFILL
NEW ORLEANS, LA
FOR
LA DEPARTMENT OF
ENVIRONMENTAL QUALITY
BATON ROUGE, LA

SLOPE STABILITY ANALYSES
WASTE STACK
YEAR 2006
(6,000 TONS PER DAY LOADING)
NORTH-SOUTH FAILURE
VICINITY OF BORING L-2

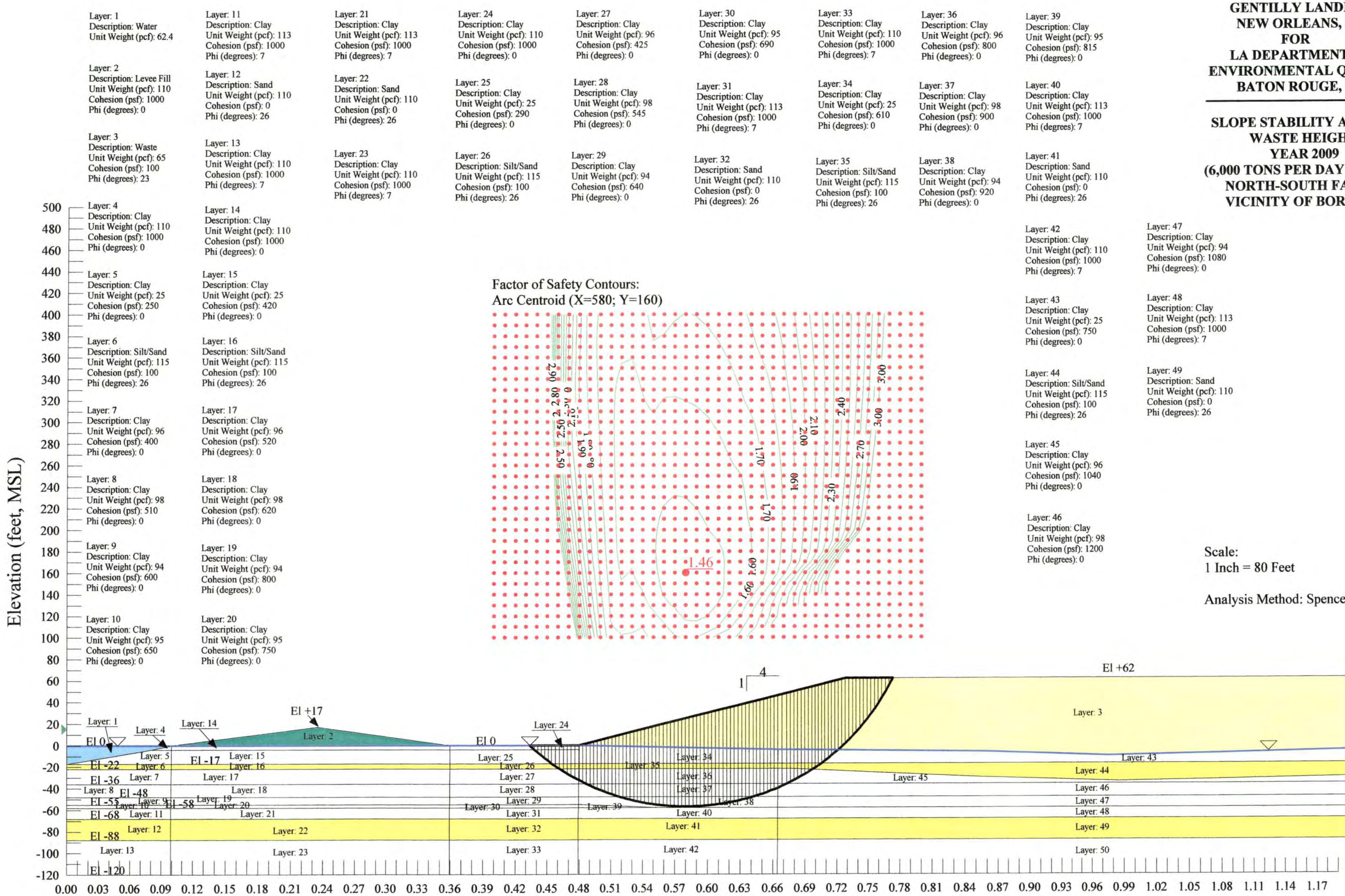


Scale:
1 Inch = 80 Feet

Analysis Method: Spencer

SOIL TESTING ENGINEERS, INC. (STE File 06-1046)

FIGURE 11



GENTILLY LANDFILL
NEW ORLEANS, LA
FOR
LA DEPARTMENT OF
ENVIRONMENTAL QUALITY
BATON ROUGE, LA

SLOPE STABILITY ANALYSES
WASTE HEIGHT
YEAR 2009
(6,000 TONS PER DAY LOADING)
NORTH-SOUTH FAILURE
VICINITY OF BORING L-2

Scale:
1 Inch = 80 Feet

Analysis Method: Spencer

SOIL TESTING ENGINEERS, INC. (STE File 06-1046)

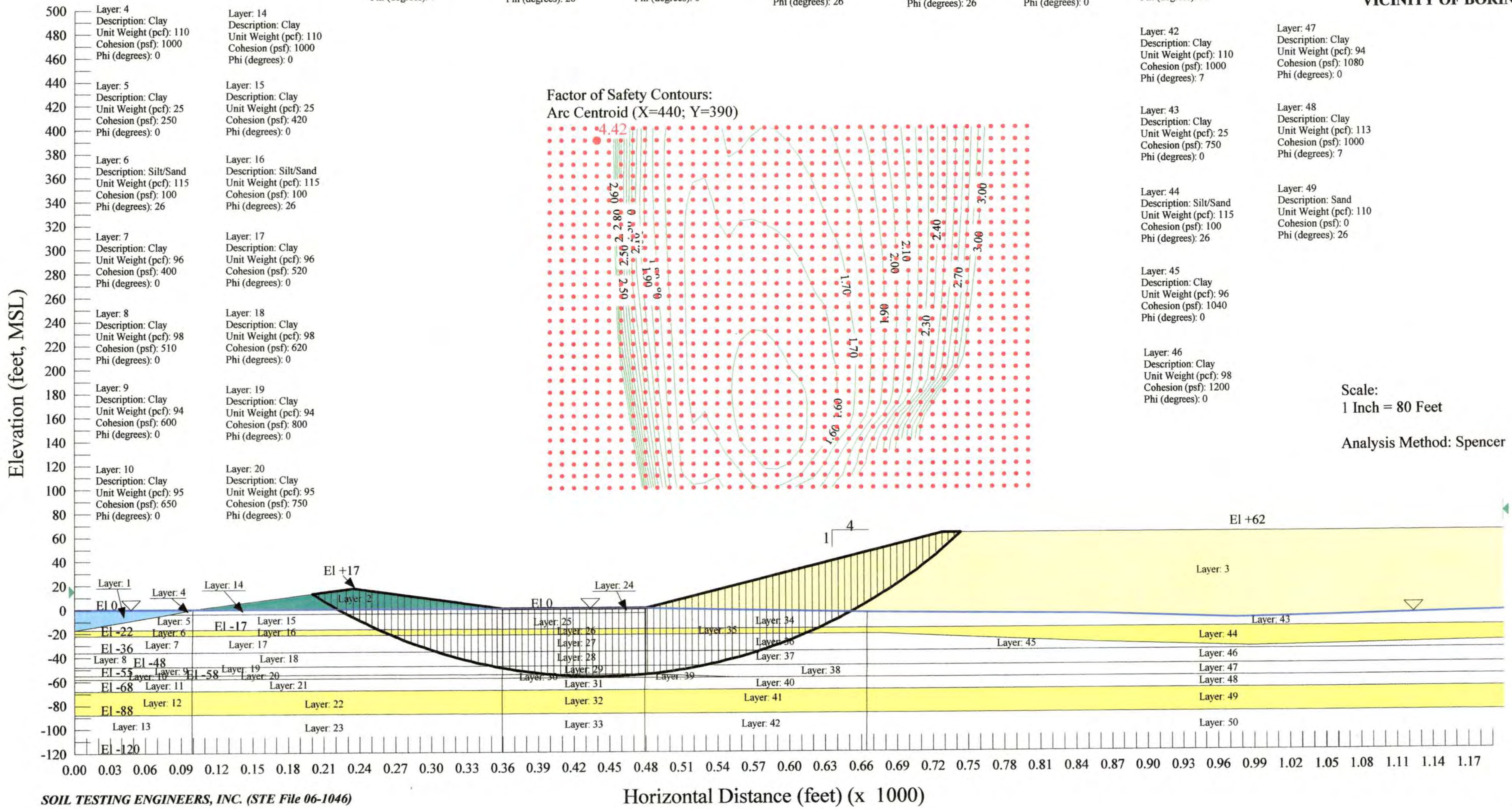
FIGURE 12

GENTILLY LANDFILL
NEW ORLEANS, LA
FOR
LA DEPARTMENT OF ENVIRONMENTAL QUALITY
BATON ROUGE, LA

SLOPE STABILITY ANALYSES
WASTE HEIGHT
YEAR 2009
(6,000 TONS PER DAY LOADING)
NORTH-SOUTH FAILURE
VICINITY OF BORING L-2

Layer	Description	Unit Weight (pcf)	Cohesion (psf)	Phi (degrees)
1	Water	62.4		
2	Levee Fill	110	1000	0
3	Waste	65	100	23
4	Clay	110	1000	0
5	Clay	25	250	0
6	Silt/Sand	115	100	26
7	Clay	96	400	0
8	Clay	98	510	0
9	Clay	94	600	0
10	Clay	95	650	0
11	Clay	113	1000	7
12	Sand	110	0	26
13	Clay	110	1000	7
14	Clay	110	1000	0
15	Clay	25	420	0
16	Silt/Sand	115	100	26
17	Clay	96	520	0
18	Clay	98	620	0
19	Clay	94	800	0
20	Clay	95	750	0
21	Clay	113	1000	7
22	Sand	110	0	26
23	Clay	110	1000	7
24	Clay	110	1000	0
25	Clay	25	290	0
26	Silt/Sand	115	100	26
27	Clay	96	425	0
28	Clay	98	545	0
29	Clay	94	640	0
30	Clay	95	690	0
31	Clay	113	1000	7
32	Sand	110	0	26
33	Clay	110	1000	7
34	Clay	25	610	0
35	Silt/Sand	115	100	26
36	Clay	96	800	0
37	Clay	98	900	0
38	Clay	94	920	0
39	Clay	95	815	0
40	Clay	113	1000	7
41	Sand	110	0	26
42	Clay	110	1000	7
43	Clay	25	750	0
44	Silt/Sand	115	100	26
45	Clay	96	1040	0
46	Clay	98	1200	0
47	Clay	94	1080	0
48	Clay	113	1000	7
49	Sand	110	0	26

Factor of Safety Contours:
Arc Centroid (X=440; Y=390)

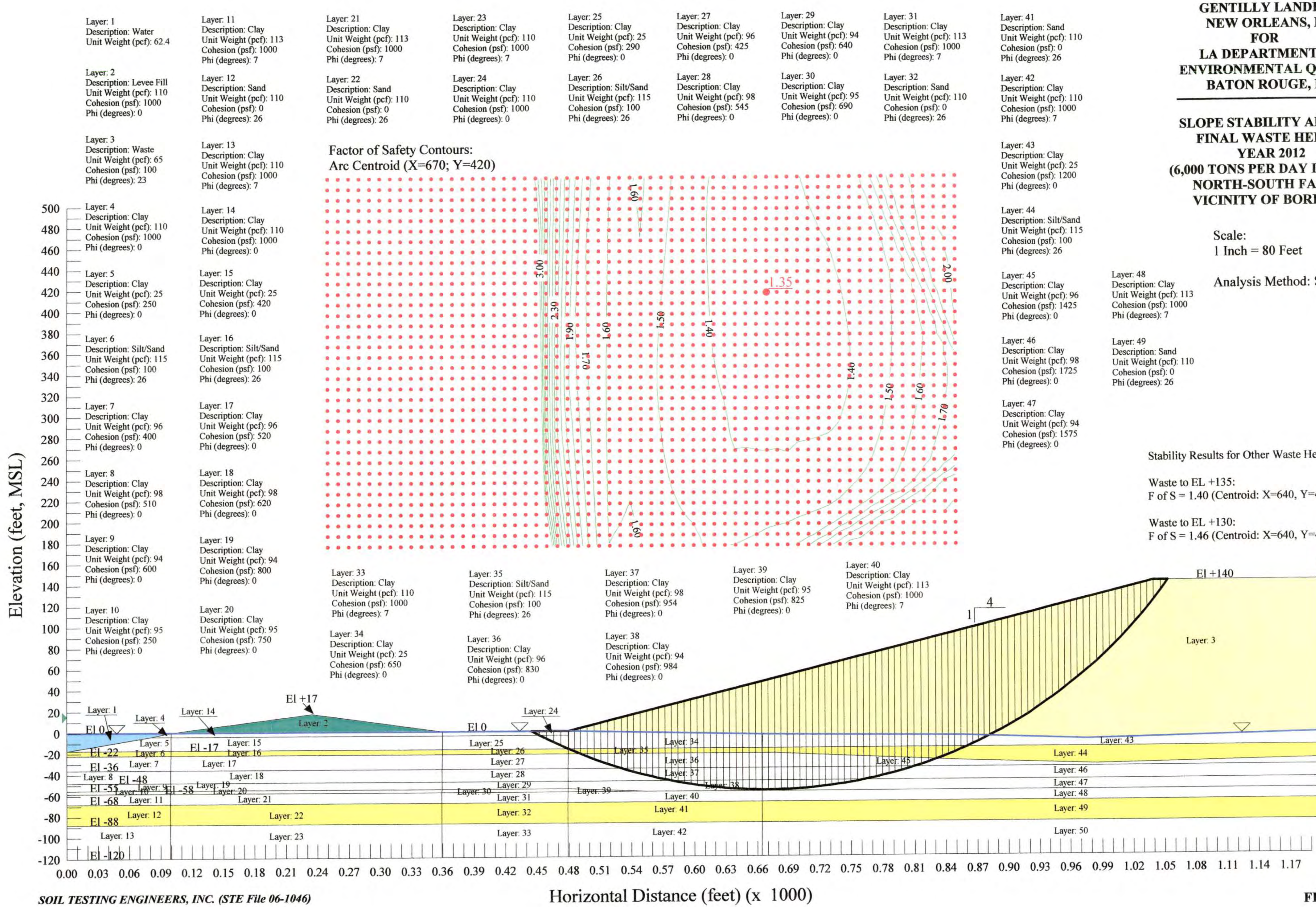


Scale:
1 Inch = 80 Feet

Analysis Method: Spencer

SOIL TESTING ENGINEERS, INC. (STE File 06-1046)

FIGURE 13



GENTILLY LANDFILL
NEW ORLEANS, LA
FOR
LA DEPARTMENT OF
ENVIRONMENTAL QUALITY
BATON ROUGE, LA

SLOPE STABILITY ANALYSES
FINAL WASTE HEIGHT
YEAR 2012
(6,000 TONS PER DAY LOADING)
NORTH-SOUTH FAILURE
VICINITY OF BORING L-2

Scale:
1 Inch = 80 Feet

Analysis Method: Spencer

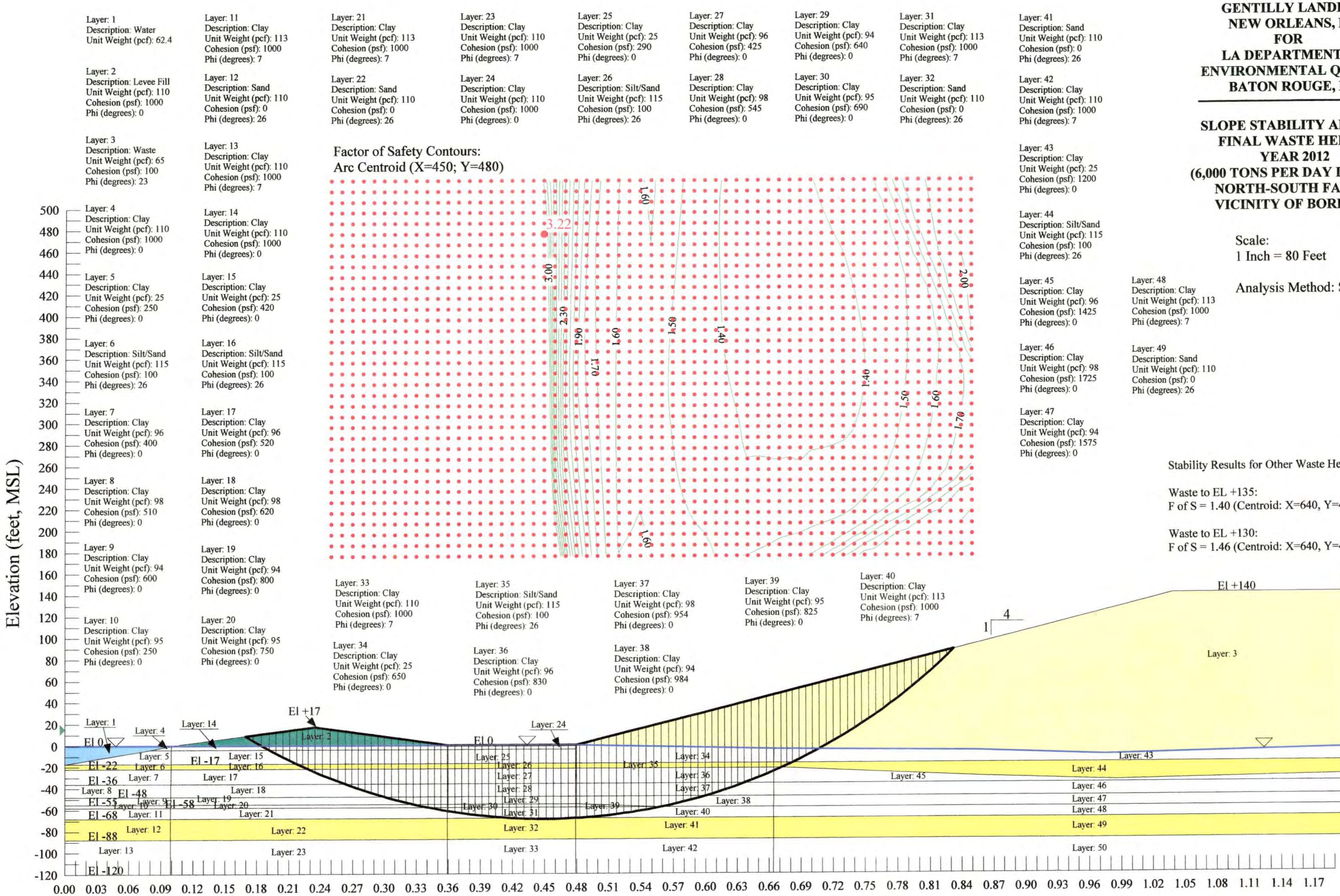
Stability Results for Other Waste Heights:

Waste to EL +135:
F of S = 1.40 (Centroid: X=640, Y=420)

Waste to EL +130:
F of S = 1.46 (Centroid: X=640, Y=420)

SOIL TESTING ENGINEERS, INC. (STE File 06-1046)

FIGURE 14



GENTILLY LANDFILL
NEW ORLEANS, LA
FOR
LA DEPARTMENT OF ENVIRONMENTAL QUALITY
BATON ROUGE, LA

SLOPE STABILITY ANALYSES
FINAL WASTE HEIGHT
YEAR 2012
(6,000 TONS PER DAY LOADING)
NORTH-SOUTH FAILURE
VICINITY OF BORING L-2

Scale:
1 Inch = 80 Feet

Analysis Method: Spencer

Stability Results for Other Waste Heights:

Waste to EL +135:
F of S = 1.40 (Centroid: X=640, Y=420)

Waste to EL +130:
F of S = 1.46 (Centroid: X=640, Y=420)

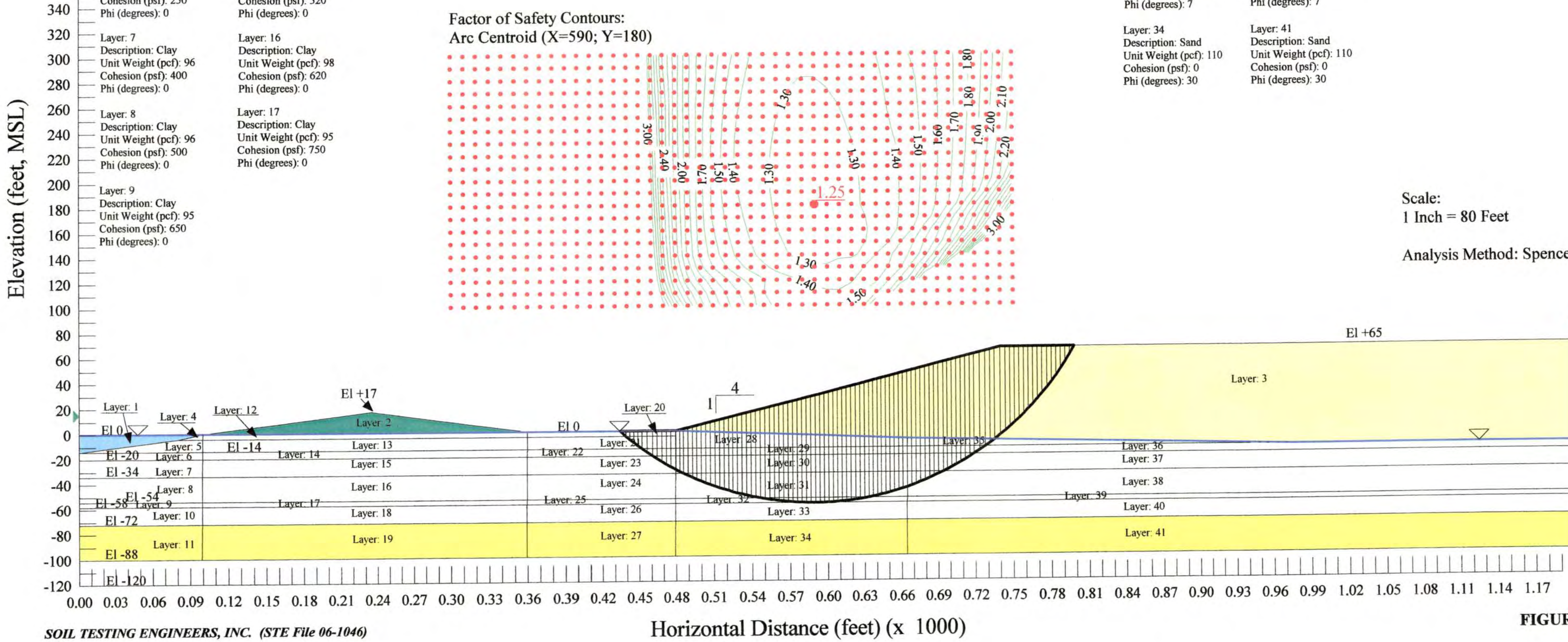
SOIL TESTING ENGINEERS, INC. (STE File 06-1046)

FIGURE 15

GENTILLY LANDFILL
NEW ORLEANS, LA
FOR
LA DEPARTMENT OF
ENVIRONMENTAL QUALITY
BATON ROUGE, LA

SLOPE STABILITY ANALYSES
WASTE STACK
YEAR 2007
(MAXIMUM LOADING RATE)
NORTH-SOUTH FAILURE
VICINITY OF BORING L-1

Layer	Description	Unit Weight (pcf)	Cohesion (psf)	Phi (degrees)
1	Water	62.4		
2	Levee Fill	110	1000	0
3	Waste	65	100	23
4	Clay	110	1000	0
5	Clay	100	250	0
6	Clay	80	250	0
7	Clay	96	400	0
8	Clay	96	500	0
9	Clay	95	650	0
10	Clay	110	1000	7
11	Sand	110	0	30
12	Clay	110	1000	0
13	Clay	100	420	0
14	Clay	80	420	0
15	Clay	96	520	0
16	Clay	98	620	0
17	Clay	95	750	0
18	Clay	110	1000	7
19	Sand	110	0	30
20	Clay	110	1000	0
21	Clay	100	250	0
22	Clay	80	250	0
23	Clay	96	400	0
24	Clay	96	500	0
25	Clay	95	650	0
26	Clay	110	1000	7
27	Sand	110	0	30
28	Clay	100	430	0
29	Clay	80	430	0
30	Clay	96	660	0
31	Clay	96	810	0
32	Clay	95	710	0
33	Clay	110	1000	7
34	Sand	110	0	30
35	Clay	100	440	0
36	Clay	80	440	0
37	Clay	96	680	0
38	Clay	96	820	0
39	Clay	95	730	0
40	Clay	110	1000	7
41	Sand	110	0	30

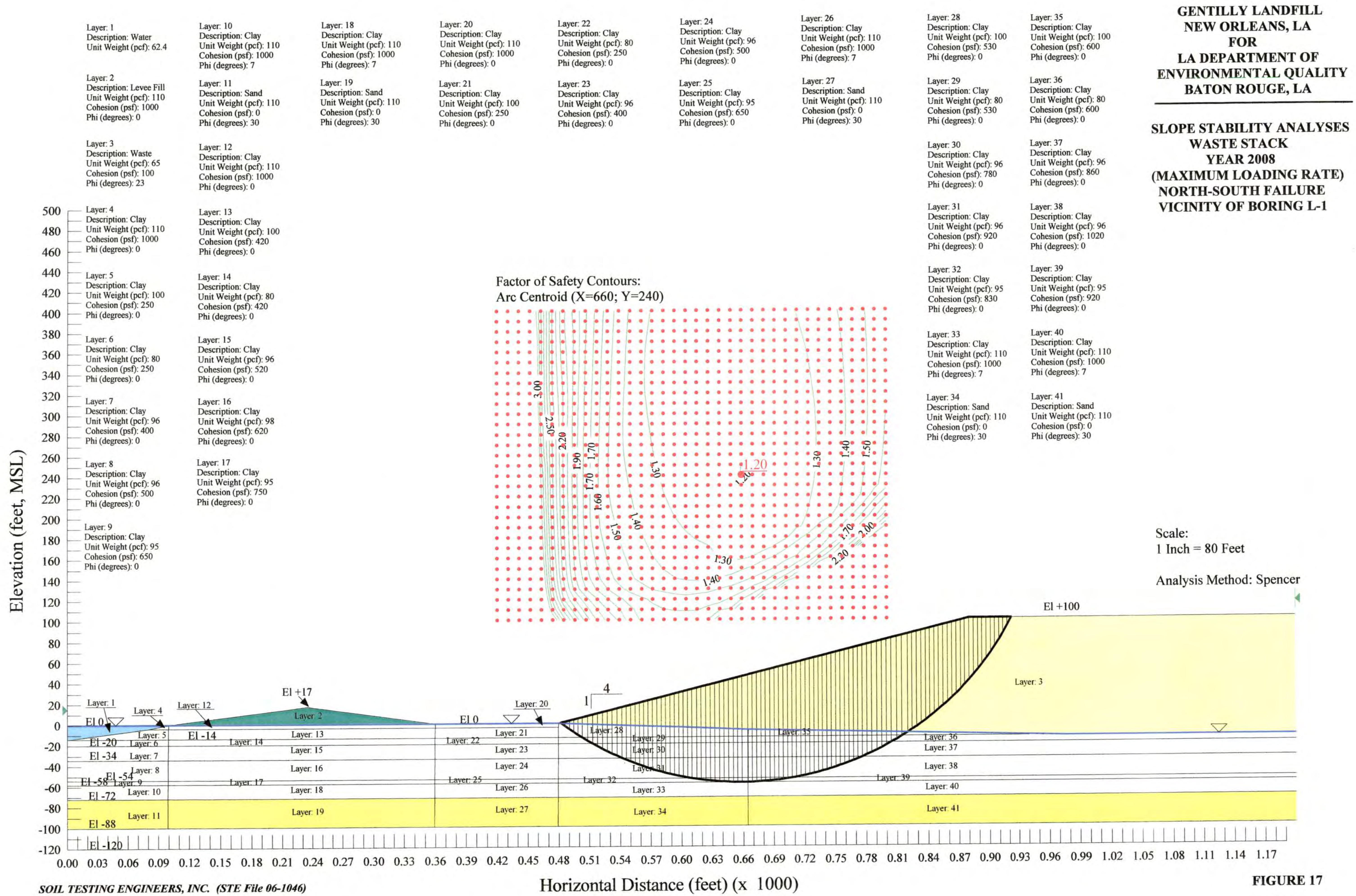


Scale:
1 Inch = 80 Feet

Analysis Method: Spencer

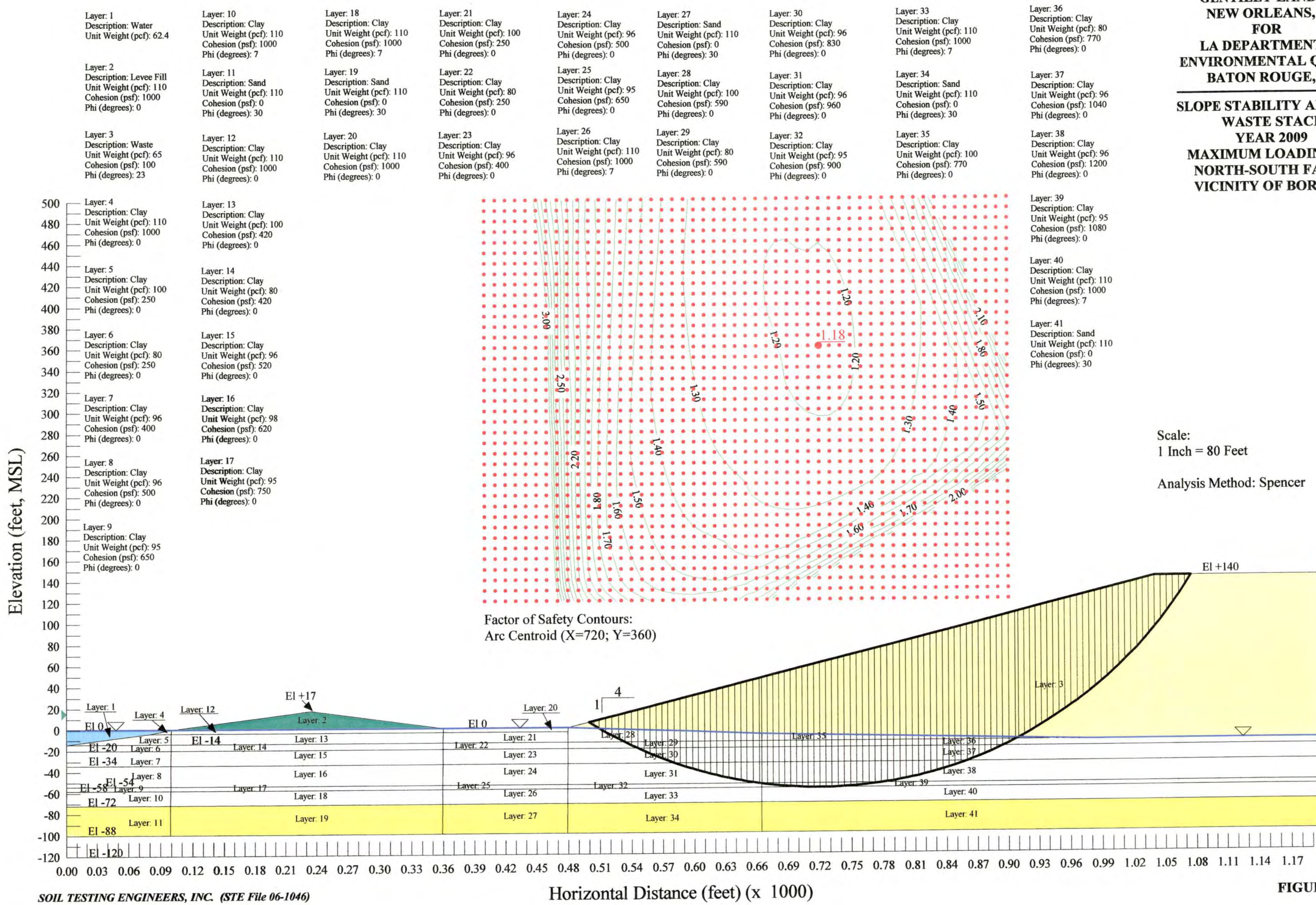
SOIL TESTING ENGINEERS, INC. (STE File 06-1046)

FIGURE 16


GENTILLY LANDFILL
NEW ORLEANS, LA
FOR
LA DEPARTMENT OF
ENVIRONMENTAL QUALITY
BATON ROUGE, LA
SLOPE STABILITY ANALYSES
WASTE STACK
YEAR 2008
(MAXIMUM LOADING RATE)
NORTH-SOUTH FAILURE
VICINITY OF BORING L-1
Scale:
1 Inch = 80 Feet
Analysis Method: Spencer
Factor of Safety Contours:
Arc Centroid (X=660; Y=240)
Layer: 1 Description: Water Unit Weight (pcf): 62.4
Layer: 2 Description: Levee Fill Unit Weight (pcf): 110 Cohesion (psf): 1000 Phi (degrees): 0
Layer: 3 Description: Waste Unit Weight (pcf): 65 Cohesion (psf): 100 Phi (degrees): 23
Layer: 4 Description: Clay Unit Weight (pcf): 110 Cohesion (psf): 1000 Phi (degrees): 0
Layer: 5 Description: Clay Unit Weight (pcf): 100 Cohesion (psf): 250 Phi (degrees): 0
Layer: 6 Description: Clay Unit Weight (pcf): 80 Cohesion (psf): 250 Phi (degrees): 0
Layer: 7 Description: Clay Unit Weight (pcf): 96 Cohesion (psf): 400 Phi (degrees): 0
Layer: 8 Description: Clay Unit Weight (pcf): 96 Cohesion (psf): 500 Phi (degrees): 0
Layer: 9 Description: Clay Unit Weight (pcf): 95 Cohesion (psf): 650 Phi (degrees): 0
Layer: 10 Description: Clay Unit Weight (pcf): 110 Cohesion (psf): 1000 Phi (degrees): 7
Layer: 11 Description: Sand Unit Weight (pcf): 110 Cohesion (psf): 0 Phi (degrees): 30
Layer: 12 Description: Clay Unit Weight (pcf): 110 Cohesion (psf): 1000 Phi (degrees): 0
Layer: 13 Description: Clay Unit Weight (pcf): 100 Cohesion (psf): 420 Phi (degrees): 0
Layer: 14 Description: Clay Unit Weight (pcf): 80 Cohesion (psf): 420 Phi (degrees): 0
Layer: 15 Description: Clay Unit Weight (pcf): 96 Cohesion (psf): 520 Phi (degrees): 0
Layer: 16 Description: Clay Unit Weight (pcf): 98 Cohesion (psf): 620 Phi (degrees): 0
Layer: 17 Description: Clay Unit Weight (pcf): 95 Cohesion (psf): 750 Phi (degrees): 0
Layer: 18 Description: Clay Unit Weight (pcf): 110 Cohesion (psf): 1000 Phi (degrees): 7
Layer: 19 Description: Sand Unit Weight (pcf): 110 Cohesion (psf): 0 Phi (degrees): 30
Layer: 20 Description: Clay Unit Weight (pcf): 110 Cohesion (psf): 1000 Phi (degrees): 0
Layer: 21 Description: Clay Unit Weight (pcf): 100 Cohesion (psf): 250 Phi (degrees): 0
Layer: 22 Description: Clay Unit Weight (pcf): 80 Cohesion (psf): 250 Phi (degrees): 0
Layer: 23 Description: Clay Unit Weight (pcf): 96 Cohesion (psf): 400 Phi (degrees): 0
Layer: 24 Description: Clay Unit Weight (pcf): 96 Cohesion (psf): 500 Phi (degrees): 0
Layer: 25 Description: Clay Unit Weight (pcf): 95 Cohesion (psf): 650 Phi (degrees): 0
Layer: 26 Description: Clay Unit Weight (pcf): 110 Cohesion (psf): 1000 Phi (degrees): 7
Layer: 27 Description: Sand Unit Weight (pcf): 110 Cohesion (psf): 0 Phi (degrees): 30
Layer: 28 Description: Clay Unit Weight (pcf): 100 Cohesion (psf): 530 Phi (degrees): 0
Layer: 29 Description: Clay Unit Weight (pcf): 80 Cohesion (psf): 530 Phi (degrees): 0
Layer: 30 Description: Clay Unit Weight (pcf): 96 Cohesion (psf): 780 Phi (degrees): 0
Layer: 31 Description: Clay Unit Weight (pcf): 96 Cohesion (psf): 920 Phi (degrees): 0
Layer: 32 Description: Clay Unit Weight (pcf): 95 Cohesion (psf): 830 Phi (degrees): 0
Layer: 33 Description: Clay Unit Weight (pcf): 110 Cohesion (psf): 1000 Phi (degrees): 7
Layer: 34 Description: Sand Unit Weight (pcf): 110 Cohesion (psf): 0 Phi (degrees): 30
Layer: 35 Description: Clay Unit Weight (pcf): 100 Cohesion (psf): 600 Phi (degrees): 0
Layer: 36 Description: Clay Unit Weight (pcf): 80 Cohesion (psf): 600 Phi (degrees): 0
Layer: 37 Description: Clay Unit Weight (pcf): 96 Cohesion (psf): 860 Phi (degrees): 0
Layer: 38 Description: Clay Unit Weight (pcf): 96 Cohesion (psf): 1020 Phi (degrees): 0
Layer: 39 Description: Clay Unit Weight (pcf): 95 Cohesion (psf): 920 Phi (degrees): 0
Layer: 40 Description: Clay Unit Weight (pcf): 110 Cohesion (psf): 1000 Phi (degrees): 7
Layer: 41 Description: Sand Unit Weight (pcf): 110 Cohesion (psf): 0 Phi (degrees): 30
El +17
El +100
El 0
El -14
El -20
El -34
El -54
El -58
El -72
El -88
El -120
Elevation (feet, MSL)
Horizontal Distance (feet) (x 1000)
SOIL TESTING ENGINEERS, INC. (STE File 06-1046)
FIGURE 17

GENTILLY LANDFILL
NEW ORLEANS, LA
FOR
LA DEPARTMENT OF
ENVIRONMENTAL QUALITY
BATON ROUGE, LA

SLOPE STABILITY ANALYSES
WASTE STACK
YEAR 2009
MAXIMUM LOADING RATE
NORTH-SOUTH FAILURE
VICINITY OF BORING L-1



Scale:
1 Inch = 80 Feet

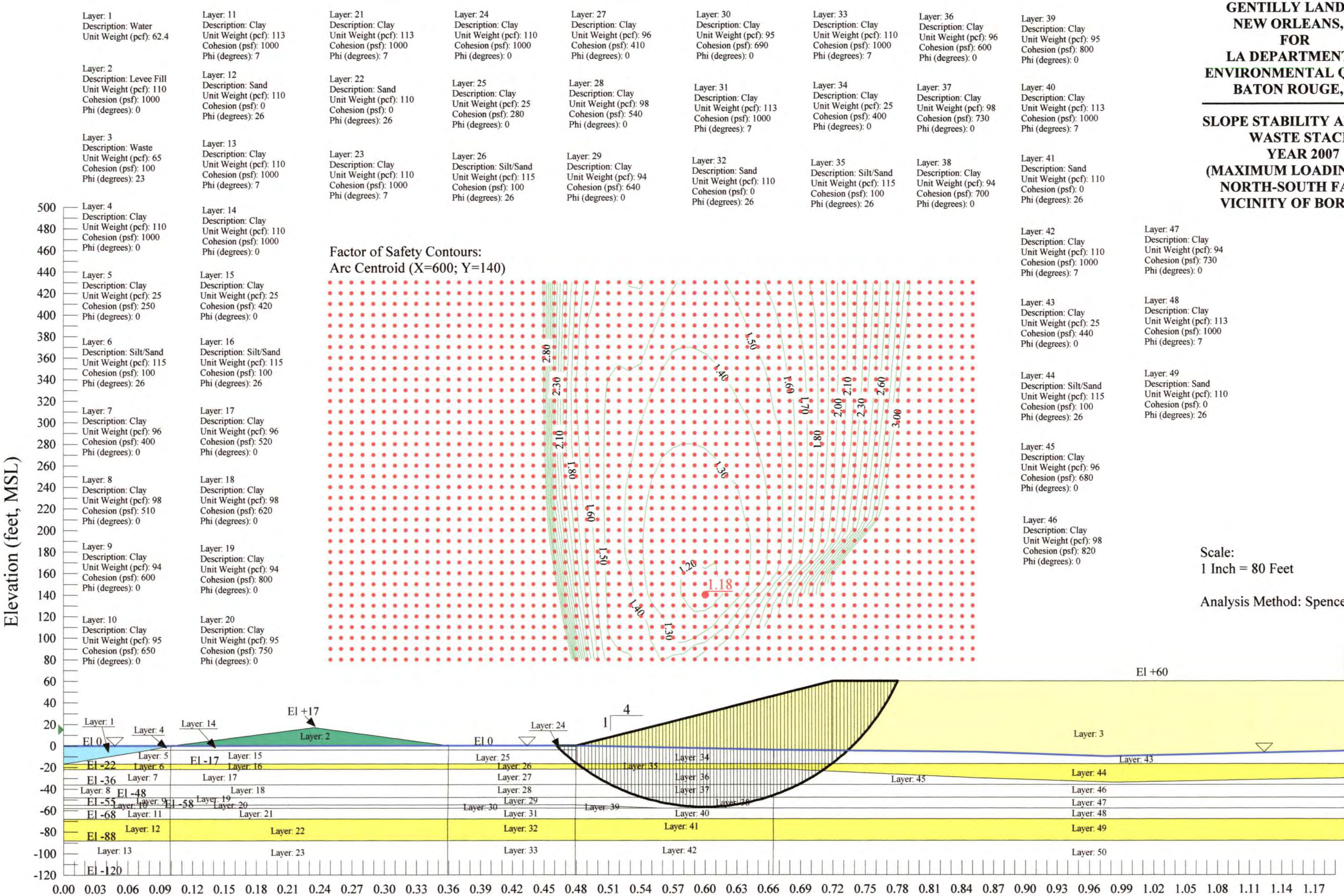
Analysis Method: Spencer

SOIL TESTING ENGINEERS, INC. (STE File 06-1046)

FIGURE 18

GENTILLY LANDFILL
NEW ORLEANS, LA
FOR
LA DEPARTMENT OF
ENVIRONMENTAL QUALITY
BATON ROUGE, LA

SLOPE STABILITY ANALYSES
WASTE STACK
YEAR 2007
(MAXIMUM LOADING RATE)
NORTH-SOUTH FAILURE
VICINITY OF BORING L-2



Scale:
1 Inch = 80 Feet

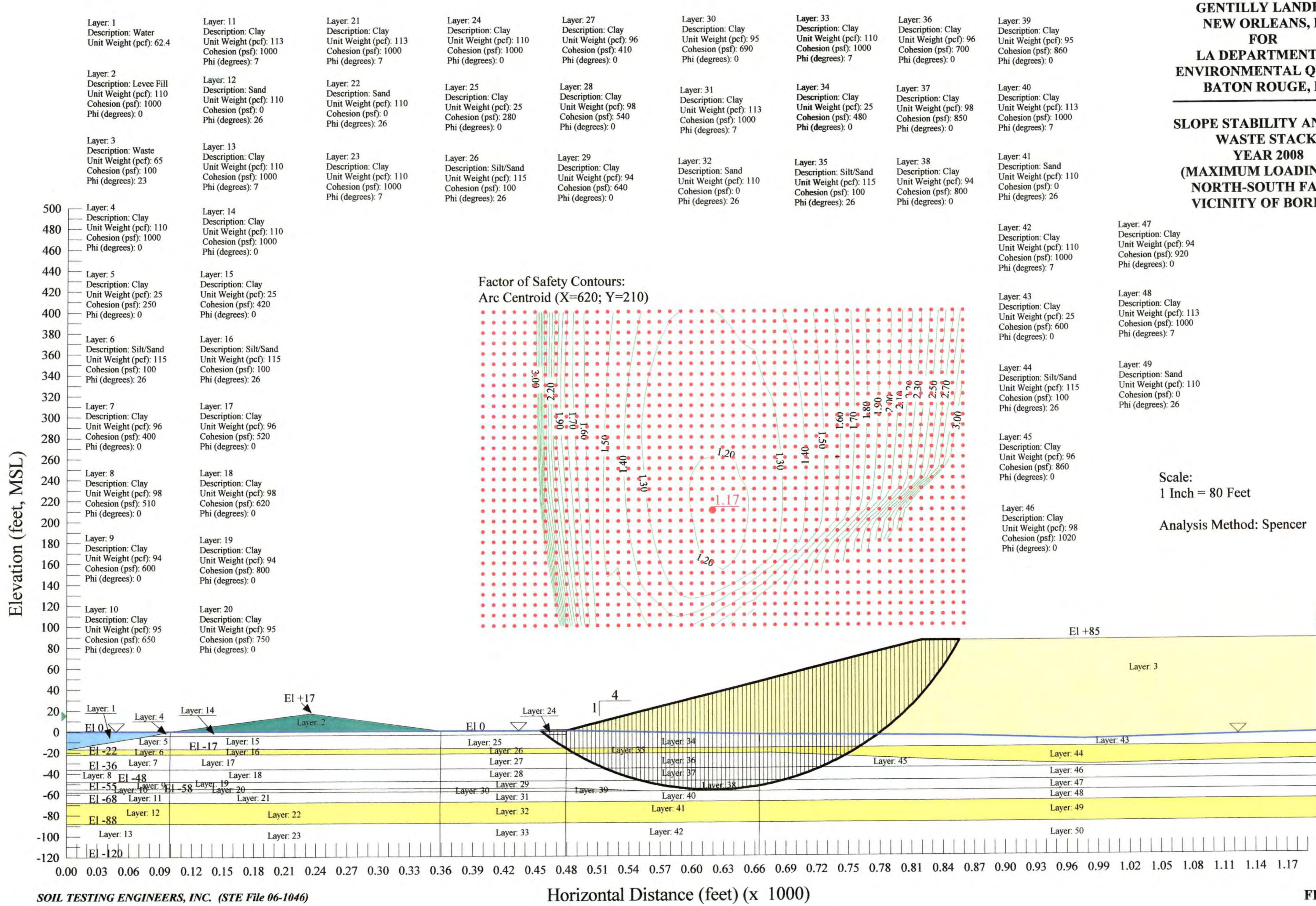
Analysis Method: Spencer

SOIL TESTING ENGINEERS, INC. (STE File 06-1046)

FIGURE 19

GENTILLY LANDFILL
NEW ORLEANS, LA
FOR
LA DEPARTMENT OF
ENVIRONMENTAL QUALITY
BATON ROUGE, LA

SLOPE STABILITY ANALYSES
WASTE STACK
YEAR 2008
(MAXIMUM LOADING RATE)
NORTH-SOUTH FAILURE
VICINITY OF BORING L-2

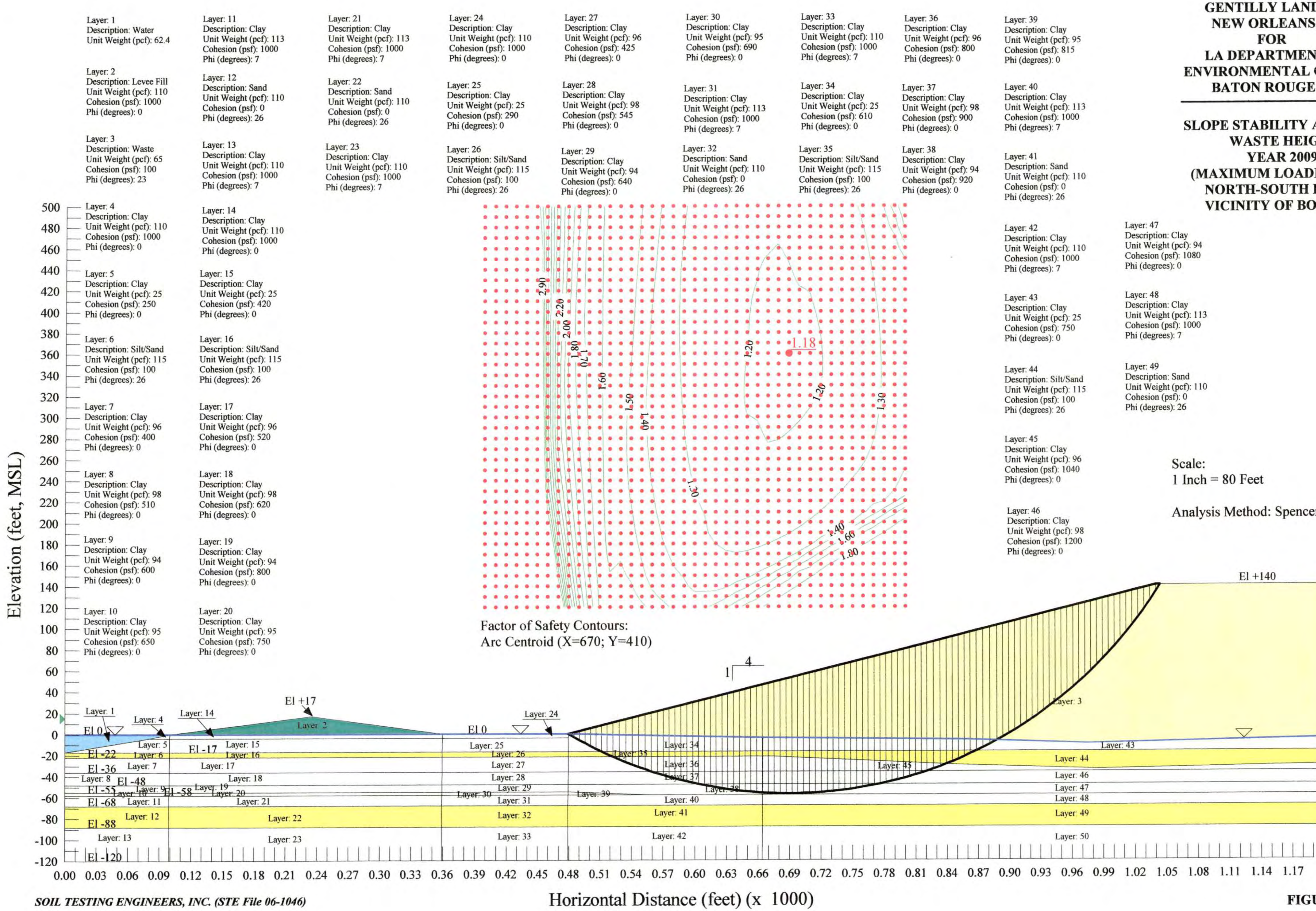


SOIL TESTING ENGINEERS, INC. (STE File 06-1046)

FIGURE 20

GENTILLY LANDFILL
NEW ORLEANS, LA
FOR
LA DEPARTMENT OF
ENVIRONMENTAL QUALITY
BATON ROUGE, LA

SLOPE STABILITY ANALYSES
WASTE HEIGHT
YEAR 2009
(MAXIMUM LOADING RATE)
NORTH-SOUTH FAILURE
VICINITY OF BORING L-2



SOIL TESTING ENGINEERS, INC. (STE File 06-1046)

FIGURE 21

INCLINOMETER INSTALLATION AND MONITORING PLAN

FOR THE

GENTILLY LANDFILL "TYPE III"

Prepared for:

AMID/METRO PARTNERSHIP, LLC
817 Hickory Avenue
Harahan, Louisiana 70123

Prepared by:

METROPLEXCORE
14423 Cornerstone Village Drive
Houston, Texas 77014

March 2006

TABLE OF CONTENTS

LIST OF APPENDICES

ft	foot / feet
LDEQ	Louisiana Department of Environmental Quality
US	United States

1.0 INTRODUCTION

The Gentilly Landfill "Type III" encompasses approximately 200 acres and is located at 10200 Almonaster Avenue in Orleans Parish, Louisiana approximately 1.5-miles West of the intersection of United States (US) Highway 51 and Almonaster Avenue. A Site Location Map is provided as Figure 1 in Attachment A.

Installation and monitoring of the inclinometers along the southern side of the Gentilly Landfill "Type III" (adjacent to the Intracoastal Canal and easement) will be performed at the request of the Louisiana Department of Environmental Quality (LDEQ) as a long terms means of monitoring the slope stability of the above grade landfilling activities on the near surface below grade subsurface materials which consist of previously buried Type II wastes, humus, sands and clays.

2.0 INSTALLATION

A total of 10 inclinometers will be installed in a phased manner along the southern boundary of the Gentilly Landfill "Type III". The inclinometers will be installed in a phased manner; Inclinometer -1 (IN-1), IN-2, IN-3, and IN-4 will be installed initially adjacent to the western portion of the site which has received waste to date. As waste placement activities relocates from the western portion of the site, to the central portion of the site and the eastern portion of the site, the additionally recommended six inclinometers will be installed before waste placement activities extend to within 200 feet (as determined by looking northerly across the site) of the proposed inclinometer locations.

Inclinometers IN-1 to IN-7 will be placed at approximate 400-foot (ft) intervals adjacent to the highest proposed elevation of the above grade landfill slopes at the site. IN-8, IN-9 and IN-10 (the eastern most proposed inclinometers) will be spaced at 600 to 800 foot intervals which correspond to lower above grade portions of the Type III landfill.

Figure 2, located in Attachment A, provides an installation plan for the initial phase of the inclinometers (IN-1 to IN-4) and Figure 3, located in Attachment A, provides the location of all ten of the proposed inclinometers.

The inclinometers will be installed to a depth of approximately 80 to 90 ft and will be terminated in the stiff highly plastic (CH) clays that have been encountered at this depth below the ground surface. The inclinometers will be installed to a minimum embedded depth of 10 into the stiff highly plastic clay. By installing the inclinometers to this depth, subsurface movement of the previously buried Type II waste, the humus layer and the sandy layer above the stiff highly plastic clay layer can be effectively monitored.

3.0 METHOD OF INSTALLATION

Qualified individuals knowledgeable in inclinometer installation techniques will install all inclinometers using rotary wash drilling methods. The boreholes may be sampled (in a geotechnical manner) prior to the installation if the inclinometer casing. Sections of 70 mm inclinometer casing will be assembled, installed to the specified depth, and grouted to the surface using the guidelines outlined in the QC Inclinometer Casing Installation Guide provided as Attachment B.

Upon completion of each inclinometer installation, a 4-ft by 4-ft concrete inclinometer pad will be constructed. In addition, a 4-inch by 4-inch steel protective casing with locking lid will be installed around the exposed inclinometer pipe and set into the concrete pad. Sand will be poured into the protective casing between the inclinometer casing and the steel protective casing to enhance the stability of the above ground pipe.

At the conclusion of the installation of the first phase of the inclinometers (IN-1 to IN-4), a report will be presented to the LDEQ which summarizes the installation process including:

- Logs of the installed inclinometers;
- A plot plan of the inclinometer locations;
- The results of any laboratory testing on soil samples obtained during the installation process;
- A discussion of the installation process; and
- The initial inclinometer readings.

The installation report will be submitted to the LDEQ within four weeks of completion of the initial phase and all subsequent installation phases.

4.0 MEASURING DEFLECTION

Attachment C provides specifications and data collection instructions that are to be used when gathering inclinometer data.

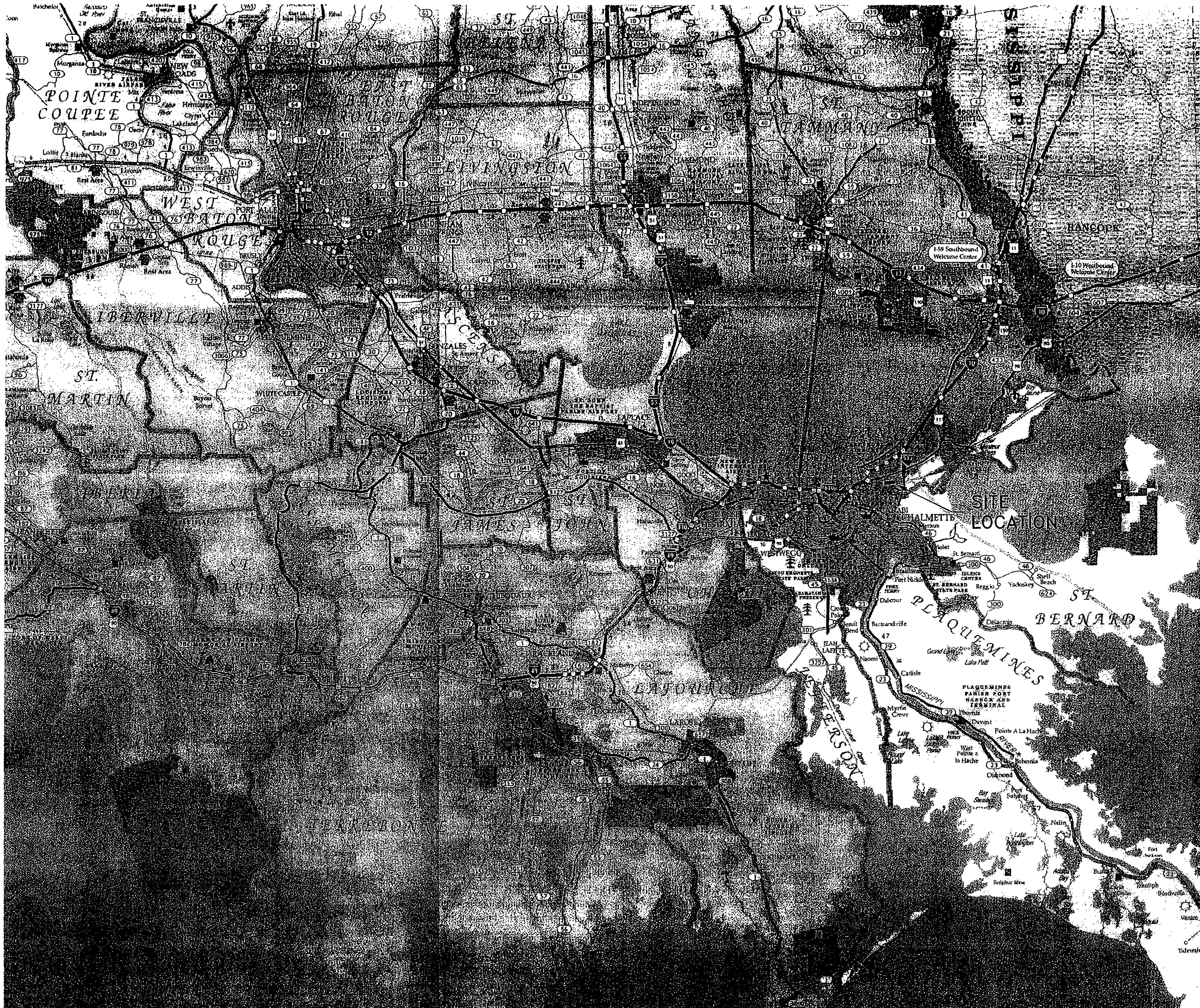
5.0 FREQUENCY

Inclinometers will be monitored to the following frequency:

- In areas where waste placement is occurring within 200 feet of an inclinometer location (as determined by looking northerly across the site), inclinometers will be measured on a weekly basis;
- In areas where waste placement is not occurring within 200 feet of an inclinometer location (as determined by looking northerly across the site), inclinometers will be monitored on a monthly basis;
- A minimum of one inclinometer reading will be obtained from the phased installation inclinometers (IN-5 to IN-10), prior to waste reaching within 100 feet (as determined by looking northerly across the site) prior to waste placement being performed within 200 feet of these inclinometers.
- In area of the site that have reached final elevations and the final cover system has been installed, quarter yearly monitoring of the inclinometers will be performed.

The result of all inclinometer readings and analysis will be submitted to the LDEQ on as quarterly basis or at a more frequent interval is determined by the site engineer.

ATTACHMENT A



10 5 0 10

SCALE MILES

REF:

2001 OFFICIAL HIGHWAY MAP OF LOUISIANA PREPARED BY THE LOUISIANA DEPARTMENT OF TRANSPORTATION AND DEVELOPMENT IN COOPERATION WITH THE LOUISIANA DEPARTMENT OF CULTURE, RECREATION AND TOURISM AND THE FEDERAL HIGHWAY ADMINISTRATION.

SITE LOCATION MAP
GENTILLY LANDFILL
"TYPE III"

Date	Revision/Description		
Drawn By	Checked By	Project No.	Dwg. Date
JMT	EQ	029002-3	05/2002

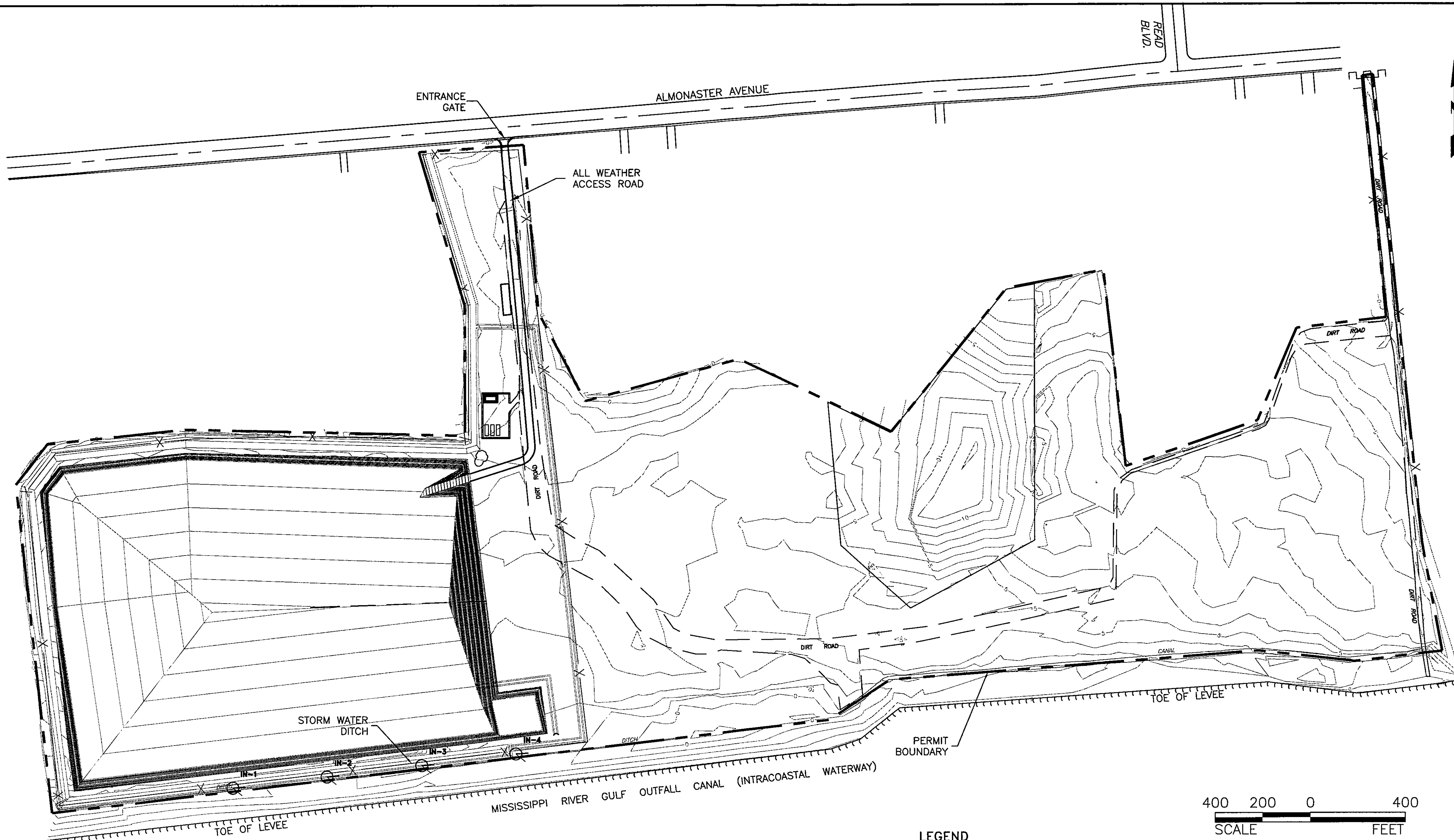
CITY OF NEW ORLEANS
SANITATION DEPARTMENT

Metroplex INDUSTRIES, INC.

14423 Cornerstone Village Drive
Houston, Texas 77014
Telephone: 281.440.5503
Facsimile: 281.444.3378

Figure No. 1

I:\CADD\029002\ 900208SM.DWG, 05/13/2002 10:09:54 AM



400 200 0 400
SCALE FEET

LEGEND

PROPERTY LINE

5' CONTOUR ELEVATION, FEET (MSL)

1' CONTOUR ELEVATION

DIRT/UNIMPROVED ROAD

IN-1 SLOPE STABILITY MONITORING INCLINOMETER

STATE OF LOUISIANA
GARY RUSSELL HORWITCH
License No. 23594
PROFESSIONAL ENGINEER
IN
CIVIL ENGINEERING

GROUND SURVEY DATE: 04/26/02
SURVEY DATA PROVIDED BY:
BFM
CORPORATION, L.L.C.
Professional Land Surveyors
534 WILLIAMS BOULEVARD
E-mail: bfmcorp@bfmcorporation.com
(504) 466-6800
Fax No. (504) 467-0065
CITY OF KENNER
JEFFERSON PARISH, LOUISIANA, 70062

I:\CADD\0290\029004\029004-012-INCLIN.dwg, 3/9/2006 7:26:39 AM

INCLINOMETER INSTALLATION PLAN – PHASE I

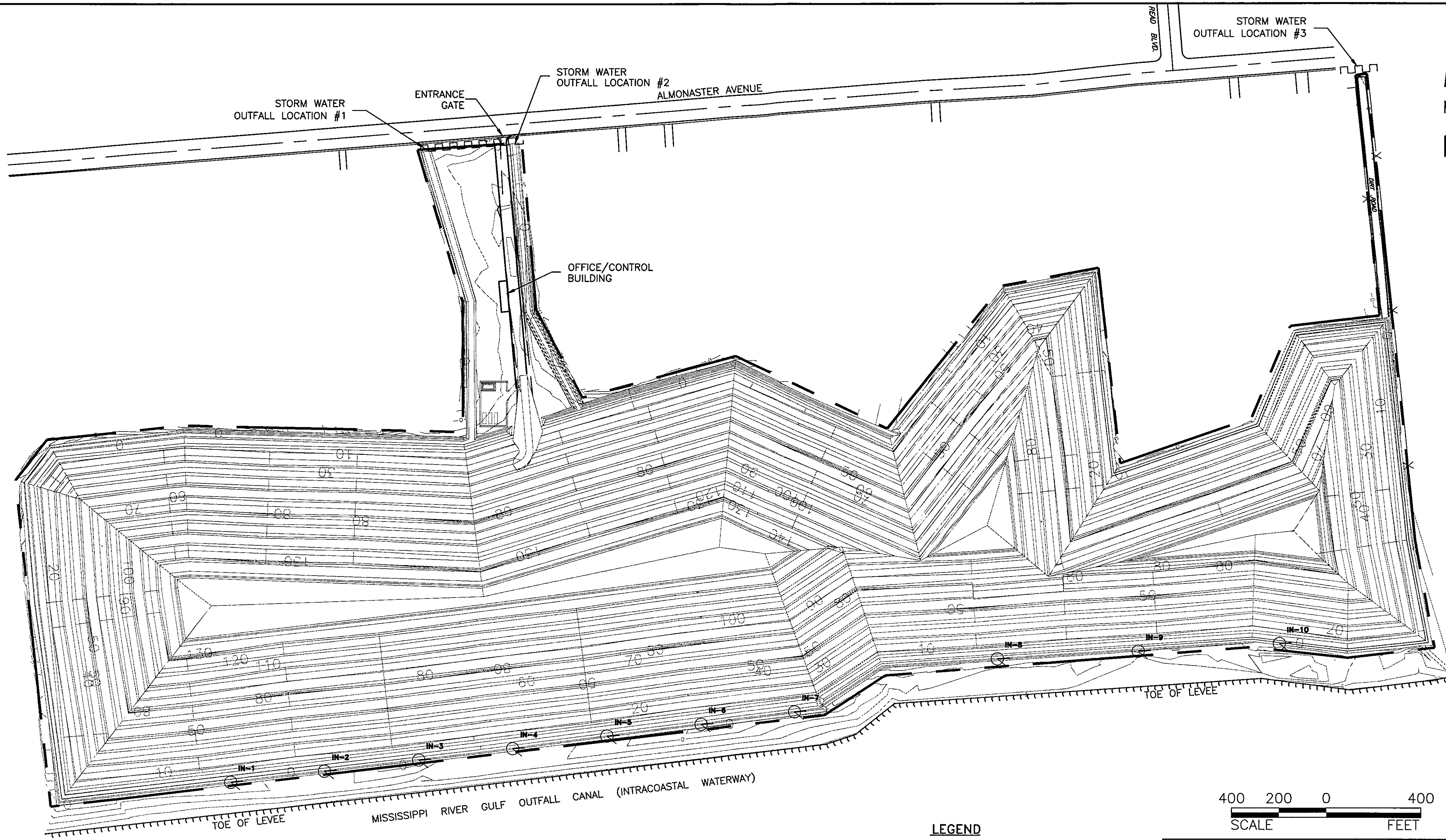
Date	Revision/Description

Drawn By	Checked By	Project No.	Dwg. Date
RGS	GRH	029002-3	03/2006

GENTILLY LANDFILL "TYPE III"
ORLEANS PARISH, LOUISIANA

Metroplex INDUSTRIES INC
14423 Cornerstone Village Drive
Houston, Texas 77014
Telephone: 281.440.5503
Facsimile: 281.444.3378

FIGURE 2



LEGEND

- PROPERTY LINE
- WASTE PLACEMENT BOUNDARY
- 10' CONTOUR ELEVATION, FEET (MSL)
- 5' CONTOUR ELEVATION
- IN-1 SLOPE STABILITY MONITORING INCLINOMETER

GROUND SURVEY DATE: 04/26/02
SURVEY DATA PROVIDED BY:

BFM CORPORATION, L.L.C.
Professional Land Surveyors
534 WILLIAMS BOULEVARD
E-mail: bfmcorp@bfmcorporation.com
(504) 468-8800
Fax No. (504) 467-0065
CITY OF KENNER
JEFFERSON PARISH, LOUISIANA, 70062

NOTE:
THE FIGURE DEPICTS FINAL CONTOURS AND LAYOUT FOR TOTAL SITE AFTER THE COMPLETION OF PHASE I, II AND III OF LANDFILL CONSTRUCTION.

STATE OF LOUISIANA
GARY RUSSELL HORWITCH
License No. 23594
PROFESSIONAL ENGINEER
IN
CIVIL ENGINEERING

INCLINOMETER INSTALLATION PLAN – FINAL CONDITIONS

Date	Revision/Description

Drawn By	Checked By	Project No.	Dwg. Date
RGS	GRH	029002-3	03/2006

GENTILLY LANDFILL "TYPE III" ORLEANS PARISH, LOUISIANA

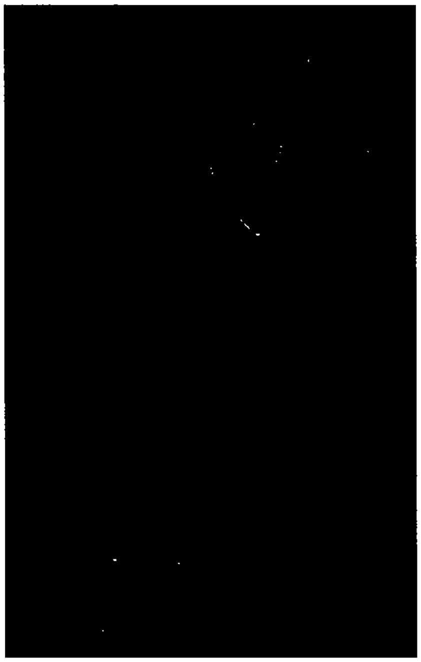
Metroplex INDUSTRIES, INC.
14423 Cornerstone Village Drive
Houston, Texas 77014
Telephone: 281.440.5503
Facsimile: 281.444.3376

FIGURE 3

I:\CADD\0290\029004\029004-013-INCLIN.dwg, 3/9/2006 7:31:58 AM

ATTACHMENT B

Inclinometer Casing



Inclinometer Casing

Inclinometer casing is a special purpose, grooved pipe used in inclinometer installations. It is typically installed in boreholes, but can also be embedded in fills, cast into concrete, or attached to structures.

Inclinometer casing provides access for the inclinometer probe, allowing it to obtain subsurface measurements. Grooves inside the casing control the orientation of the probe and provide a surface from which repeatable tilt measurements can be obtained.

Choosing Inclinometer Casing

Although Slope Indicator casing is competitively priced, price should never be the deciding factor in choosing inclinometer casing. The cost of casing is quite small relative to the cost of mobilizing a drill rig, and very small relative to the cost of a failed installation.

This page summarizes the most important factors to consider when choosing casing.

Casing Diameter

Casing is designed to deform with movement of the adjacent ground or structure. The useful life of the casing ends when continued movement of the ground pinches or shears the casing, preventing passage of the inclinometer probe. Larger diameter casing generally provides longer life.

85mm (3.34") Casing is suitable for landslides and long term monitoring. It is also appropriate for monitoring multiple shear zones or very narrow shear zones, and it is required for the horizontal Digitilt inclinometer probe.

70mm (2.75") Casing is suitable for construction projects. It can also be used for slope stability monitoring when only a moderate degree of deformation is anticipated.

48mm (1.9") Casing is suitable for applications where small deformations are distributed over broad zones. It is generally not installed in soils.

Casing Grooves

Measurement accuracy is directly influenced by the quality of casing grooves. Slope Indicator optimizes casing grooves for the wheels of the Digitilt inclinometer probe, providing a flat surface for the wheels and also the extra width needed when the probe must pass through cross-axis curvature. Groove spiral is also tightly controlled.

Casing Strength

In borehole installations, the annular space around the casing is usually backfilled with grout. The grouting process can generate pressure high enough to cause the casing to collapse. In deep installations, the pressure of grout must be controlled by stage grouting, but in other cases, the casing must be strong enough to withstand the normal pressure of grouting. Slope Indicator uses thick-walled pipe and carefully controls the depth of the grooves.

Sealable Couplings

If casing joints are not adequately sealed, grout can force its way into the casing and later prevent the probe from reaching its intended depth.

Slope Indicator offers several types of couplings and casings, all of which can be sealed easily and consistently. Our newest designs feature O-ring seals, and our older designs feature tight-fitting surfaces that are fused together with solvent cement.

Assembly

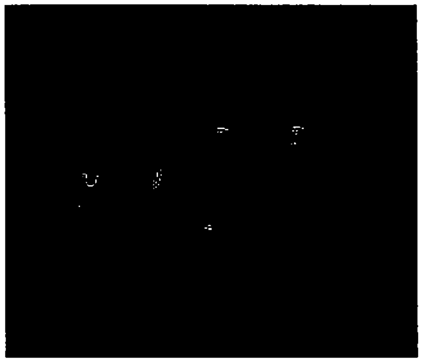
Inclinometer casing should be easy to assemble, even with an untrained crew. Slope Indicator's QC casing, which snaps together, is the current leader in quick and easy assembly. Other types of casing are assembled with shear wires or with solvent cement.

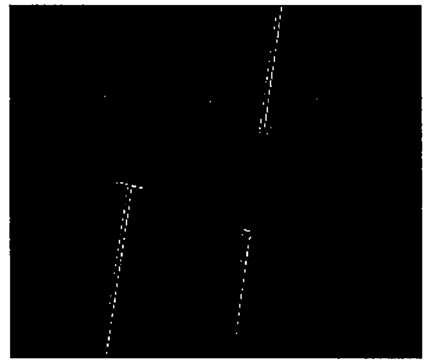
Casing Materials

Slope Indicator uses only ABS plastic for its casing for several reasons. ABS plastic retains its shape and flexibility over a wider range of temperatures than PVC plastic. ABS plastic is much easier to handle and seal than fiberglass casing. Finally, ABS plastic is suitable for long term contact with all types of soils, grouts, and ground water, unlike aluminum casing, which is no longer recommended for any application.

Installation Information

Visit the technical support section at www.slopeindicator.com to find recommended grout mixes, ways to counter casing buoyancy, and notes on other installation issues.





QC CASING

QC (Quick Connect) casing features snap-together convenience and strong, flush joints.

Grooves: Grooves are machine broached for excellent control of width, chamfer, depth, straightness, and spiral.

Sealing: O-ring seals prevent entry of grout.

Coupling: Built-in couplings snap together to make a flush joint. Unique locking mechanism engages full inner circumference of casing, providing much stronger joints than other snap-type casings.

Assembly: Press casing sections together until joint snaps closed. The resulting joint is strong, flush, and grout-proof. Solvent cement, rivets, or tape are not required. O-ring lubricant is applied at factory. Extra O-rings and lubricant are supplied with each box of casing.

Best for: General use.

QC Casing 85mm · 3.34"

Casing OD: 85 mm, 3.34 inches.
Casing ID: 73 mm, 2.87 inches.
Collapse Rating: 12.4 bar, 180 psi.
Load Rating: 635 kg, 1400 lb.
Temp rating: -29 to 88 °C, -20 to 190 °F.
Spiral: ≤ 0.33° per 3m or 10' section.

QC Casing 70mm · 2.75"

Casing OD: 70 mm, 2.75 inches.
Casing ID: 59 mm, 2.32 inches.
Collapse Rating: 16.5 bar, 240 psi.
Load Rating: 635 kg, 1400 lb.
Temp rating: -29 to 88 °C, -20 to 190 °F.
Spiral: ≤ 0.33° per 3m or 10' section.

STANDARD CASING

Slope Indicator's traditional inclinometer casing features high-strength, flush joints and is available in three diameters.

Grooves: Grooves are machine broached for excellent control of width, chamfer, depth, straightness, and spiral.

Sealing: Solvent cement and tape.

Coupling: Precision molded couplings have interference fit for high-strength bonding. Small diameter version has integral couplings.

Assembly: Casing and couplings are glued together with ABS solvent cement, riveted, and wrapped with tape.

Best for: General use. The extra-strong joints are helpful in very deep boreholes and oversize boreholes in which casing is not well supported.

Standard Casing 85mm · 3.34"

Coupling OD: 89 mm, 3.51 inches.
Casing OD: 85 mm, 3.34 inches.
Casing ID: 73 mm, 2.87 inches.
Collapse Rating: 10.6 bar, 155 psi.
Load Rating: 320 kg, 700 lb.
Temp rating: -29 to 88 °C, -20 to 190 °F.
Spiral: ≤ 0.33° per 3m or 10' section.

Standard Casing 70mm · 2.75"

Coupling OD: 70 mm, 2.75 inches.
Casing OD: 70 mm, 2.75 inches.
Casing ID: 59 mm, 2.32 inches.
Collapse Rating: 15 bar, 220 psi.
Load Rating: 320 kg, 700 lb.
Temp rating: -29 to 88 °C, -20 to 190 °F.
Spiral: ≤ 0.33° per 3 m or 10' section.

Standard Casing 48mm · 1.9"

Casing OD: 48 mm, 1.9 inches.
Casing ID: 38 mm, 1.5 inches.
Collapse Rating: 24 bar, 350 psi.
Load Rating: 320 kg, 700 lb.
Temp rating: -29 to 88 °C, -20 to 190 °F.
Spiral: ≤ 0.33° per 3 m or 10' section.

EPIC CASING

EPIC casing is an economical casing that can be cut and coupled at any point along its length.

Grooves: Grooves are formed during extrusion and are less precise than broached grooves.

Sealing: Solvent cement, mastic, and tape.

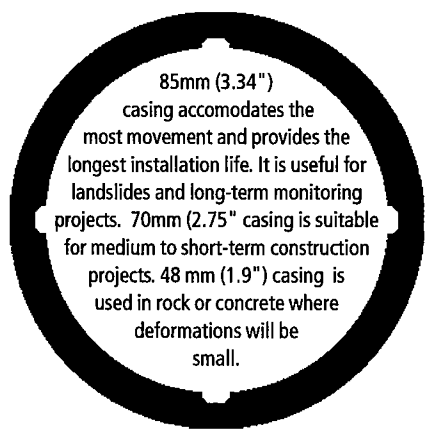
Coupling: Oversize couplings make very strong joints.

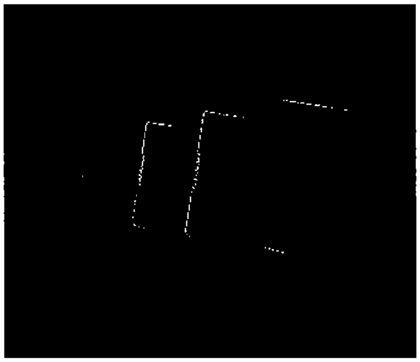
Assembly: Casing and couplings are glued together with ABS solvent cement. The joint must then be sealed with mastic and tape.

Best for: General use. Some care must be taken to seal the coupling.

EPIC Casing 70mm · 2.75" Only

Coupling OD: 78 mm, 3.07 inches.
Casing OD: 70 mm, 2.75 inches.
Casing ID: 60 mm, 2.32 inches.
Collapse Rating: 15 bar, 220 psi.
Load Rating: 320 kg, 700 lb.
Temp rating: -29 to 88 °C, -20 to 190 °F.
Spiral: ≤ 0.5° per 3m or 10' section.





CPI CASING

CPI casing features quick assembly and disassembly and is available in 3 diameters.

Grooves: Grooves are machine broached for excellent control of width, chamfer, depth, straightness, and spiral.

Sealing: O-ring seals prevent entry of grout.

Coupling: Oversize couplings and shear wires make high strength joint.

Assembly: Apply grease to O-rings, press coupling onto casing, and insert shear wire.

Best for: Cold weather assembly or temporary installations that involve repeated disassembly.

CPI Casing 85mm · 3.34"

Coupling OD: 94 mm, 3.7 inches.
Casing OD: 85 mm, 3.34 inches.
Casing ID: 73 mm, 2.87 inches.
Collapse Rating: 11 bar, 155 psi.
Load Rating: 635 kg, 1400 lb.
Temp rating: -29 to 88 °C, -20 to 190 °F.
Spiral: ≤ 0.33° per 3m or 10' section.

CPI Casing 70mm ·2.75"

Coupling OD: 76 mm, 3 inches.
Casing OD: 70 mm, 2.75 inches.
Casing ID: 59 mm, 2.32 inches.
Collapse Rating: 15 bar, 220 psi.
Load Rating: 400 kg, 900 lb.
Temp rating: -29 to 88 °C, -20 to 190 °F.
Spiral: ≤ 0.33° per 3m or 10' section.

CPI Casing, 48mm · 1.9"

Coupling OD: 54 mm, 2.12 inches.
Casing OD: 48 mm, 1.9 inches.
Casing ID: 38 mm, 1.5 inches.
Collapse Rating: 24 bar, 350 psi.
Load Rating: 320 kg, 900 lb.
Temp rating: -29 to 88 °C, -20 to 190 °F.
Spiral: ≤ 0.33° per 3 m or 10' section.

SHEAR-WIRE CASING

Shear-Wire casing features flush joints that can be assembled easily in cold weather.

Grooves: Grooves are machine broached for excellent control of width, chamfer, depth, straightness, and spiral.

Sealing: O-ring seals prevent entry of grout.

Coupling: Built-in couplings lock together with removable nylon shear wire to make flush joint.

Assembly: Press casing sections together, then insert shear wire. The result is a flush, grout-proof joint. Solvent cement, rivets, and tape are not required. O-ring lubricant is applied at the factory. Extra O-rings, lubricant, and shear wires are supplied with each box of casing.

Best for: Easy assembly in weather that is too cold for solvent cement or snap-together joints. Generally used in water-filled boreholes.

Shear Wire Casing 85mm · 3.34"

Casing OD: 85 mm, 3.34 inches.
Casing ID: 73 mm, 2.87 inches.
Collapse Rating: 12.4 bar, 180 psi.
Load Rating: 225 kg, 500 lb.
Temp rating: -29 to 88 °C, -20 to 190 °F.
Spiral: ≤ 0.33° per 3m or 10' section.

Shear Wire Casing 70mm · 2.75"

Casing OD: 70 mm, 2.75 inches.
Casing ID: 59 mm, 2.32 inches.
Collapse Rating: 16.5 bar, 240 psi.
Load Rating: 225 kg, 500 lb.
Temp rating: -29 to 88 °C, -20 to 190 °F.
Spiral: ≤ 0.33° per 3m or 10' section.

GROUT VALVES

Grout valves allow placement of grout backfill in boreholes that cannot accommodate an external grout pipe. The one-way valve is installed in the bottom section of casing. A grout pipe is lowered through the casing to mate with the grout valve and deliver the grout.

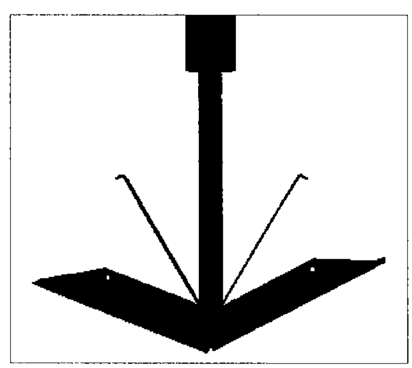
TELESCOPING SECTIONS

Optional telescoping sections accommodate 150 mm (6 inches) of compression or extension. Fully extended, each telescoping section adds 0.76 m (2.5 feet) of length to the casing

CASING ANCHORS

In its fluid state, grout exerts an uplift force that can push even water-filled casing out of the borehole. Holding the casing down from the top has unfortunate side-effects: the casing goes into compression and snakes from side to side in the borehole. Thus casing curvature is present from the start, and slight variations in the positioning of the probe are more likely to produce reading errors..

The casing anchor, installed in place of the bottom cap, provides a convenient way to counter casing buoyancy and reduces casing curvature, since the casing self-centers in the borehole. The anchor has spring loaded arms that are activated when a pin is pulled. Anchors are available for 70 mm and 85 mm casing.



QC CASING 85MM · 3.34"

Casing Section, 10' (3.05 m) 51150310
Casing Section, 5' (1.52 m) 51150311
Section, Telescoping............. 51150320
Cap, Bottom.................... 51150330
Cap, Bottom, Heavy Duty.......... 51101520
Grout Valve, Gasket Type.......... 51100830
Cap, Top....................... 51100500
Cap, Locking 51100550
Splice Kit, Male 51150350
Splice Kit, Female................ 51150351

QC CASING 70mm · 2.75"

Casing Section,10' (3.05 m) 51150210
Casing Section, 5' (1.52 m) 51150211
Section, Telescoping............. 51150220
Cap, Bottom.................... 51150230
Cap, Bottom, Heavy Duty.......... 51100520
Grout Valve, Gasket Type.......... 51100820
Cap, Top....................... 51101500
Cap, Locking 51101550
Splice Kit, Male 51150250
Splice Kit, Female................ 51150251

STANDARD CASING 85mm · 3.34"

Casing Section, 10' (3.05 m) 51100100
Casing Section, 5' (1.52 m) 51100105
Telescoping Section 51106400
Coupling 51100200
Cap, Bottom, Heavy Duty.......... 51101520
Grout Valve, Gasket Type.......... 51100830
Cap 51100500
Cap, Locking 51100550
Pop Rivet AD44H 51103301

STANDARD CASING 70mm · 2.75"

Casing Section, 10' (3.05 m) 51101100
Casing Section, 5' (1.52 m) 51101105
Telescoping Section 51107400
Coupling 51101200
Cap, Bottom, Heavy Duty.......... 51100520
Grout Valve, Gasket Type.......... 51100820
Cap 51101500
Locking Cap with Padlock 51101550
Pop Rivet AD42H 51003303

STANDARD CASING 48mm · 1.9"

Casing Section, 5' (1.52 m) 51102305
Cap 51102500
Locking Cap with Padlock 51102550
Grout Valve, Gasket Type.......... 51104000

EPIC CASING 70mm · 2.75"

Casing Section, 10' (3.05 m) 51111100
Coupling....................... 51111200
Telescoping Coupling 51111400
Cap, Bottom, Heavy Duty.......... 51100520
Grout Valve, Gasket Type.......... 51100820
Cap........................... 51111500
Locking Cap with Padlock.......... 51101550
Pop Rivet AD46H 51003310
Lubricant for Telescoping Coupling... 57504000

CPI CASING 85mm · 3.34"

Casing Section, 10' (3.05 m)........ 57500100
Casing Section, 5' (1.52 m) 57500105
Telescoping Section 57506400
Coupling with 2 Shear Wires........ 57500200
Cap with Shear Wire.............. 57500500
Grout Valve, Gasket Type.......... 57503500
Cap, Top....................... 51100500
Spare Nylon Shear Wire 57500700
O-Ring Lubricant................. 57504000

CPI CASING 70mm · 2.75"

Casing Section, 10' (3.05 m) 57501100
Casing Section, 5' (1.52 m) 57501105
Telescoping Section 57507400
Coupling with 2 Shear Wires........ 57501200
Cap with Shear Wire.............. 57501500
Grout Valve, Gasket Type.......... 57503600
Cap, Top....................... 51101500
Spare Nylon Shear Wire 57501700
O-Ring Lubricant................. 57504000

CPI CASING 48mm · 1.9"

Casing Section, 5' (1.52 m) 57502105
Coupling with 2 Shear Wires........ 57502200
Cap with Shear Wire.............. 57502500
Grout Valve, Gasket Type.......... 57503700
Cap, Top....................... 51102500
Spare Nylon Shear Wire 57502700
O-Ring Lubricant................. 57504000

SHEAR WIRE CASING 85mm · 3.34"

10' (3.05 m) Casing Section.........51160310
5' (1.52 m) Casing Section..........51160311
Section, Telescoping 51160320
Cap, Bottom 51160330
Cap, Bottom, Heavy Duty 51101520
Grout Valve, Gasket Type 51100830
Cap, Top 51100500
Cap, Locking....................51100550

SHEAR WIRE CASING 70mm · 2.75"

Casing Section, 10' (3.05 m)........51160210
Casing Section, 5' (1.52 m).........51160211
Section, Telescoping 51160220
Cap, Bottom 51160230
Cap, Bottom, Heavy Duty 51100520
Grout Valve, Gasket Type 51100820
Cap, Top 51101500
Cap, Locking....................51101550

CASING ANCHORS

Casing Anchor, 85 mm (3.34") 51104385
Casing Anchor, 70 mm (2.75") 51104370
Anchor + Grout Valve, 85mm (3.34") .51104485
Anchor + Grout Valve, 70mm (2.75") .51104470

INSTALLATION ACCESSORIES

Mastic Sealing Tape 51003800
Vinyl Tape 51003900
Duct Tape 51004000
ABS Solvent Cement, 1/2 pint.......51103401
ABS Solvent Cement, 1 pint.........51103402
Pop Rivet Gun 50100202
Casing Clamp 50100200

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QC Inclinometer Casing Installation Guide

51150099

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Inclinometer casing should be installed by technically-qualified personnel. This publication is provided as a guide only and is not intended to substitute for the expertise of a qualified engineer or to supersede project specifications or instruction manuals.

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SLOPE INDICATOR

SINCO 70001920 0697

Contents

1

Introduction

The Advantages of QC Inclinometer Casing

QC inclinometer casing combines the quality and precision of Slope Indicator's traditional inclinometer casing with a patented* coupling system that saves time and virtually eliminates assembly mistakes.

The patented QC coupling system provides snap-together convenience and creates strong, flush joints without glue, rivets, or tape. The QC joint won't pull part. It won't twist out of alignment. It won't break if you bend it. And it won't leak or collapse under the pressure of grout.

Quality and precision are easily seen in the spiral-free, machine-broached guide grooves. The shape of the grooves promotes repeatable positioning of the inclinometer probe. The uniform depth of the grooves prevents weak spots along the casing wall that could fail under the pressure of grout.

If you're an engineer who requires accurate inclinometer data, or if you are installer who needs reliable casing that installs quickly, you'll like the way QC inclinometer casing performs.

*US Patent #5,015,014

QC Casing Part Numbers

85 mm (3.34 inch) Casing	Part No.
10-Foot Section	51150310
5-Foot Section	51150311
Telescoping Section	51150320
Bottom Cap	51150330
Top Cap	51100500
Locking Cap with Padlock	51100550
Splice Kit, Male	51150350
Splice Kit, Female	51150351
85 mm Grout Valve, Gasket-Type	51150335
85 mm Grout Valve, Quick-Connect	51150340
Pipe Clamp	50100200

70 mm (2.75inch) Casing	Part No.
10-Foot Section	51150210
5-Foot Section	51150211
Telescoping Section	51150220
Bottom Cap	51150230
Top Cap	51101500
Locking Cap with Padlock	51101550
Splice Kit, Male	51150250
Splice Kit, Female	51150251
70 mm Grout Valve, Gasket-Type	51150235
70 mm Grout Valve, Quick-Connect	51150240
Pipe Clamp	50100200

QC Casing PerformanceTests

During the development of QC casing, Slope Indicator established a series of tests to quantify and improve the strength of QC coupling system. The final testing of QC casing was observed by Pacific Testing Laboratories and the results of the testing were certified in a report entitled "Engineering Review of Inclinometer Casing Strength Tests." Please contact Slope Indicator if you are interested in obtaining a copy of the PTL report.

Pull Test

Purpose: To test the performance of QC casing joints under tensile loads.

Materials: QC casing section samples, loading frame, and NIST-traceable equipment including a calibrated hydraulic ram and pressure gauge.

Procedure: The casing section samples were assembled and mounted in the loading frame. The samples were loaded until the casing joints failed.

Results: Both 85 mm (3.34 inch) and 70 mm (2.75 inch) casing sample joints withstood 635 kg (1400 lb) of tension.

Torque Test

Purpose: To test the performance of QC casing joints under twisting forces that could cause misalignment of casing grooves.

Materials: QC casing section samples, torque test frame with lever arm, NIST Class F traceable weights.

Procedure: The casing section samples were assembled and mounted in the torque test frame. The weight suspended from the lever arm was increased until the casing joints failed.

Results: Both 85 mm (3.34 inch) and 70 mm (2.75 inch) casing sample joints withstood 33 N.m (25 ft.lb) of torque.

Bending Test

Purpose: To test the performance of QC casing joints under bending moments.

Materials: QC casing sections, a test frame, and NIST Class F traceable weights.

Procedure: Casing sections were assembled and then supported at opposite ends, with the unsupported joint in the middle. Weights were suspended from the casing sections on both sides of the joint to create a bending moment across the joint. Weight was then increased until the joint failed.

Results: Both 85 mm (3.34 inch) and 70 mm (2.75 inch) casing joints withstood a bending moment of 186 N.m (140 ft.lb).

Pressure Test

Purpose: To test the O-ring seals and the collapse strength of the QC joint by subjecting them to compressive forces.

Materials: QC casing sections, a water-filled pressure vessel, and an NIST-traceable pressure gauge.

Procedure: Casing sections were assembled and placed in the pressure vessel, which was designed to apply pressure to the casing wall and joint, but not to casing ends, which were left open to atmosphere. Water pressure was increased until the casing failed.

Results: The 85 mm (3.34 inch) casing joints withstood a minimum of 12.4 bar (180 psi). The 70 mm (2.75 inch) casing joints withstood 16.5 bar (240 psi).

2

Assembling QC Casing

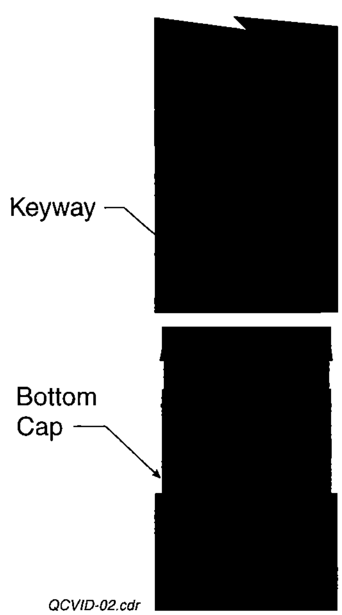
Assembling QC Casing

QC Casing Sections

Each section of casing has a male end with an alignment key, an O-ring, and a lock ring, and a female end with a keyway. It takes about 30 pounds to snap two sections of casing together.

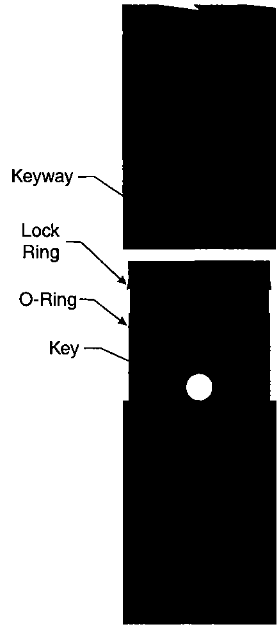
The O-ring and lock-ring are greased at the factory and protected by a cap. At assembly time, remove the cap and check that the O-ring and lock ring are still greased. Be sure to keep casing ends clean.

Installing a Bottom Cap or Grout Valve



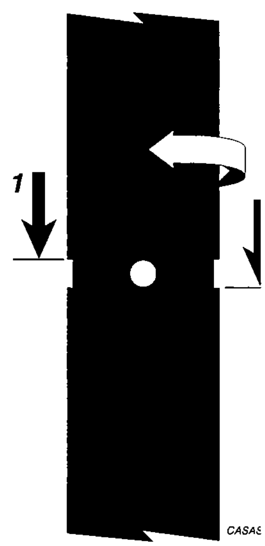
1. Remove protective cap.
2. Place bottom cap or grout valve on ground with male end up.
3. Push female end of casing section onto bottom cap or grout valve. You will hear a "snap" as the lock ring is seated.

Assembling Casing Sections



1. Remove protective caps and check that O-ring and lock ring are greased.
2. Align the key and keyway of the two sections.
3. Push the sections together until the joint snaps closed. If the O-ring is caught in the keyway, pull the sections apart and start again.

Speed Hint



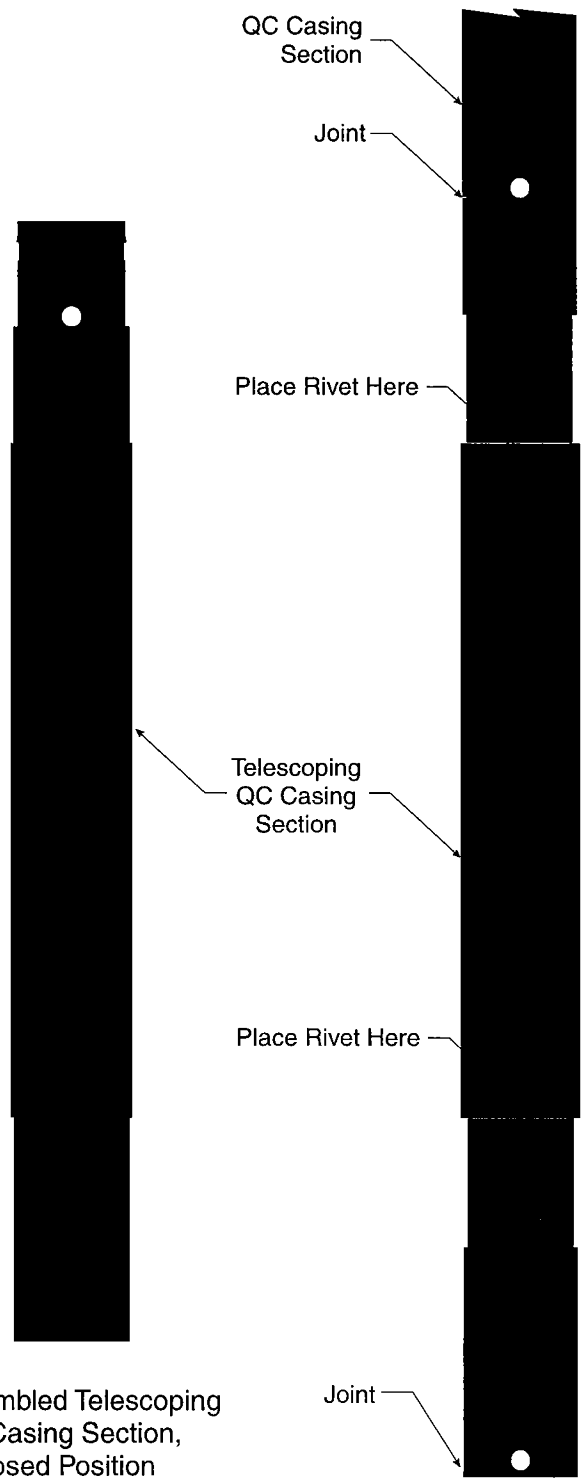
You may find this alternative assembly procedure easier:

1. Push the sections together until the end of the casing touches the alignment key.
2. Turn the casing into alignment.
3. Snap the joint closed.

Assembling Telescoping Sections

Each QC telescoping section allows six inches of compression or extension. The sliding sleeves of the section are equipped with QC ends, allowing the telescoping section to be inserted between two QC casing sections.

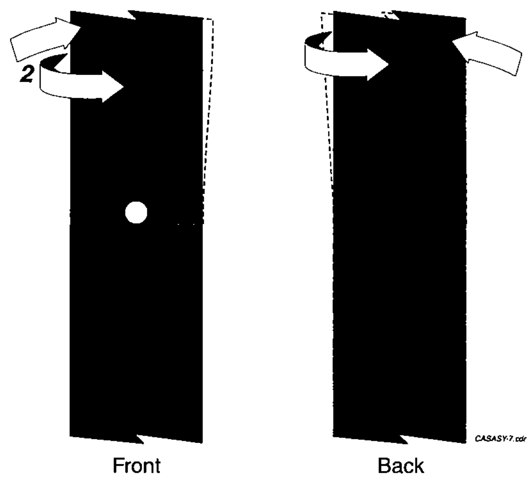
To accommodate settlement, the telescoping sections should be installed with sleeves extended. Use one rivet to hold each sleeve. Place the rivet about 1/2 inch from the edge of the section body and aligned with the key and keyway (see drawing on the next page). To counter buoyancy, be sure to apply a down force to the bottom of the casing. The single rivets may not hold if you apply a down force from the top.



Unassembled Telescoping
QC Casing Section,
Closed Position

Taking Apart QC Casing

1. Use a hacksaw to cut the casing. Start cutting just below the alignment key. End the cut about 3½ to 4 inches above the joint as shown in the drawing. Cut through the first layer of casing only. Do not allow cuts to intersect.
2. Pry the casing loose, starting at the key. Then bend the casing until you can remove it.



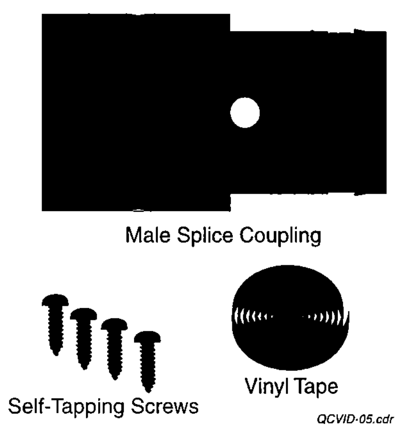
Reassembling QC Casing

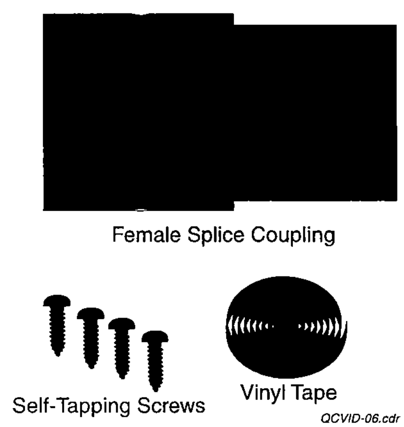
1. Remove burrs and rough edges.
2. Glue and rivet the reassembled joint. Place rivets at 90 degree intervals around the joint, starting the first rivet just above the keyway.
3. Seal the entire joint with tape.

Splicing QC Casing

Damaged QC casing can be repaired using a QC casing splice kit. Splice kits include a male or female coupling, self-tapping screws, and vinyl tape. You will need a hacksaw, drill, and screwdriver.

1. Cut off damaged casing. Remove burrs.
2. Slide the splice coupling onto the end of the casing and align it with the grooves in the casing.
3. Drill holes in the casing using the pre-drilled holes on the splice coupling as a guide.
4. Insert the self-tapping screws into the pre-drilled holes and screw them into the casing.
5. Seal the joint with vinyl tape.
6. The casing section now has a good QC end and can be used normally.





3

Installing QC Casing

Installation Concerns

How to Store Casing

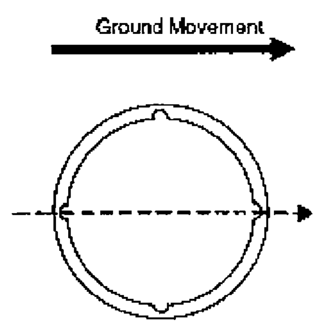
Casing should be supported evenly so that it does not warp or bend during storage. In the field, keep casing in the shade, if possible, since prolonged exposure to the heat of direct sunlight can cause deformation.

Check Borehole Depth

Check the depth of the borehole before you begin installing the casing. Also consider that grout valves or external weights may require a deeper borehole.

Align Grooves with Direction of Movement

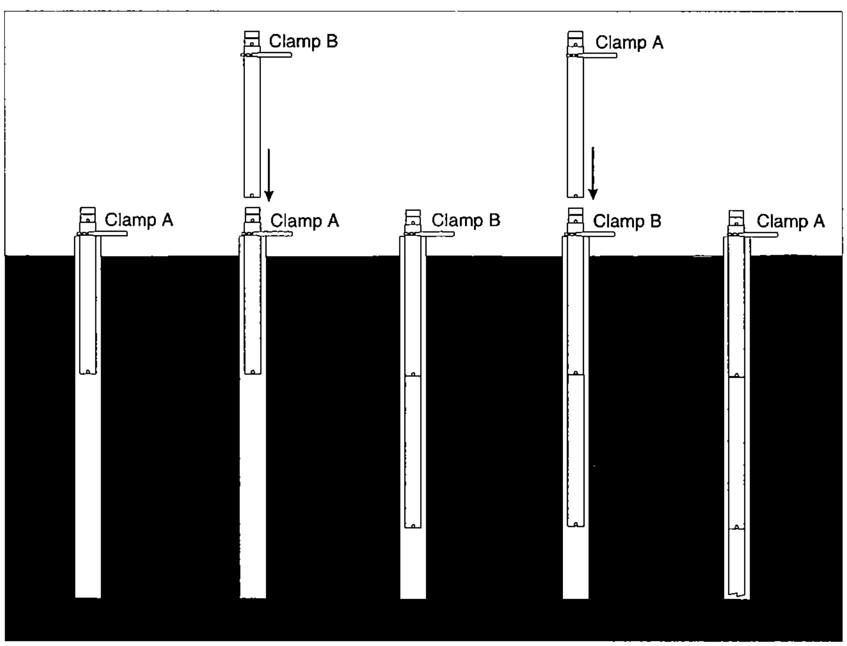
It is important to align one set of casing grooves with the expected direction of movement (see drawing below). A guide line is printed on the casing to help you maintain this orientation.



Using Pipe Clamps

Use pipe clamps to hold the casing at the borehole collar while you add the next section of casing. In dry boreholes or in situations where down hole problems seem likely, rig a safety line to provide extra security and a way to retrieve the casing, if necessary.

1. Attach Clamp A to the top of the first section of casing. Lower the casing into the borehole until the clamp rests on the borehole collar.
2. Attach Clamp B to the top of the next section. After you snap the new section onto the casing, remove Clamp A and lower the new section into the borehole until Clamp B rests on the borehole collar.
3. Now attach Clamp A to the next section of casing, make the joint and lower it into the borehole. Continue alternating Clamp A and clamp B on successive sections of casing.



Casing Buoyancy

Casing will float in water-filled boreholes, so you must fill it with water to install it down hole. However, when you pump grout into the borehole, the water-filled casing becomes buoyant again, because the grout is denser than water.

To counter this buoyancy, you should apply a down force at the bottom of the casing. You can lower a steel pipe to the bottom of the casing or you can suspend a non-retrievable weight from the bottom of the casing when you install it. A suspended weight requires a deeper borehole and may require use of a safety line.

Note that a down force applied at the top of the casing is likely to distort the casing profile. For this reason, we recommend that you do not park a drill rig over the casing or apply any other top-down method of counteracting buoyancy.

Grouting

You will need a mixer, a grout pump, a pipe or hose for delivering the grout, and optionally, a grout valve installed in the bottom section of the casing. We recommend that you do not mix the grout by hand. We also recommend that you do not use a water pump to place the grout, since pumping grout would damage it.

Properly mixed grout should be free of lumps. It has to be thin enough to pump but thick enough to set in a reasonable length of time. If the mixture is too watery, it will shrink excessively, leaving the upper portion of the borehole ungrouted. Also, avoid the use of admixtures and grouts that cure at high temperature since these may damage the casing.

Grouting continued

Grout Mixes for Inclinometers

Mix cement with water first. Then mix in the bentonite. Adjust the amount of bentonite to produce a grout within the consistencey of heavy cream. If the grout is too thin, the solids and the water will separate. If the grout is too th8ick, it will be difficult to pump.

The mix for hard and medium soils has a 28 day compressive strenth of about 100 psi, similar to hard clay. The modulus is about 10,000 psi.

The mix for soft soils has a 28 day compressive strength of about 4 psi, similar to very soft clay.

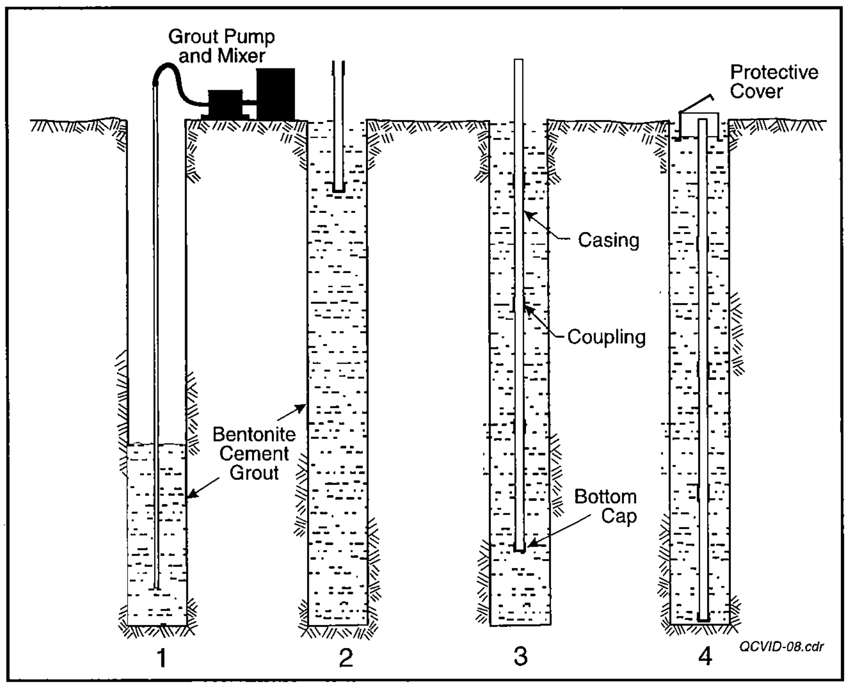
Bentonite-Cement Grout for Hard and Medium Soils		
Materials	Weight	Ratio by Weight
Portland Cement	94 lb (1 bag)	1
Bentonite	25 lb (as required)	0.3
Water	30 gallons	2.5

Bentonite-Cement Grout for Soft Soils		
Materials	Weight	Ratio by Weight
Portland Cement	94 lb (1 bag)	1
Bentonite	39 lb (as required)	0.4
Water	75 gallons	6.6

Installation Methods

Pre-Grouting the Borehole

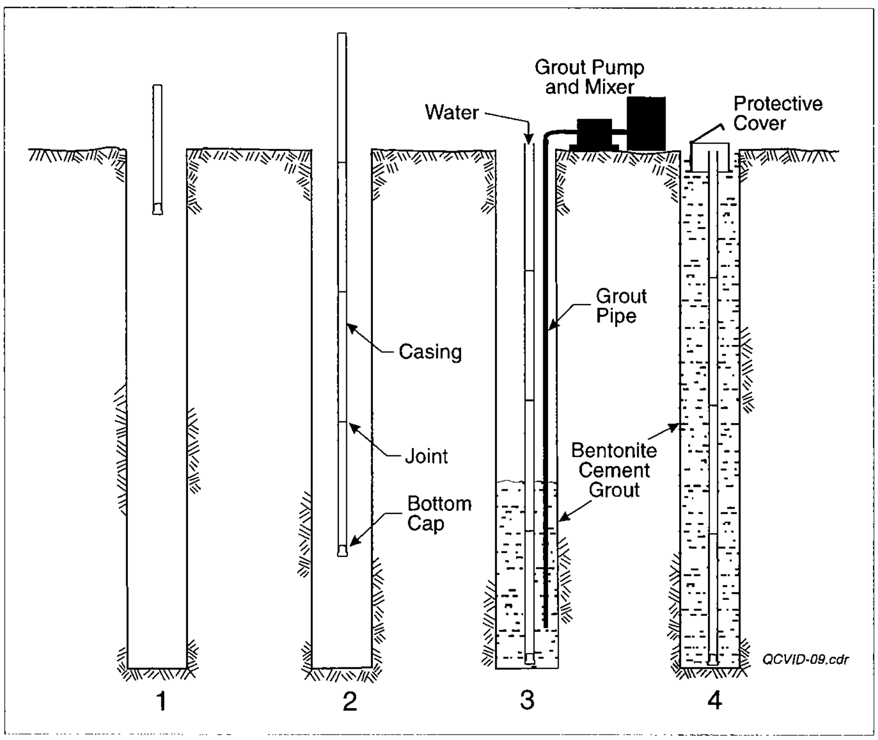
1. Clear the borehole of debris. Check the borehole depth. Lower the grout pipe to the bottom of the borehole. Pump in the grout and then retrieve the grout pipe.
2. Attach the bottom cap to the bottom section of casing.
3. Install casing to the specified depth. Keep casing filled with water to counteract buoyancy.
4. Lower a steel bar or drill pipe to the bottom of the casing to counteract buoyancy. Allow the grout to set. Later, top off the borehole with grout and install a protective cover.



Using an External Grout Pipe

This method is used in boreholes that have room for a grout pipe (or hose) in the annulus between the casing and the borehole wall.

1. Clear the borehole of debris. Check the borehole depth. Attach bottom cap. Attach grout hose, if used.
2. Install casing to the specified depth. Lower pipe to the bottom of the casing to counteract buoyancy. Cap the casing to prevent entry of grout.
3. Lower the grout pipe to the bottom of the borehole and pump in grout. You may have to "jet" the pipe into place by pumping a mixture of grout and water. Then pump in grout and retrieve the grout pipe.
4. Allow the grout to set. Later, top off the borehole with grout and install a protective cover.



Using a Grout Valve

Grout valves are used when casing is installed in small diameter boreholes that do not allow use of an external grout pipe. The grout valve is a one-way valve installed in the bottom cap of the casing. A grout pipe is lowered through the casing to mate with the grout valve and deliver grout.

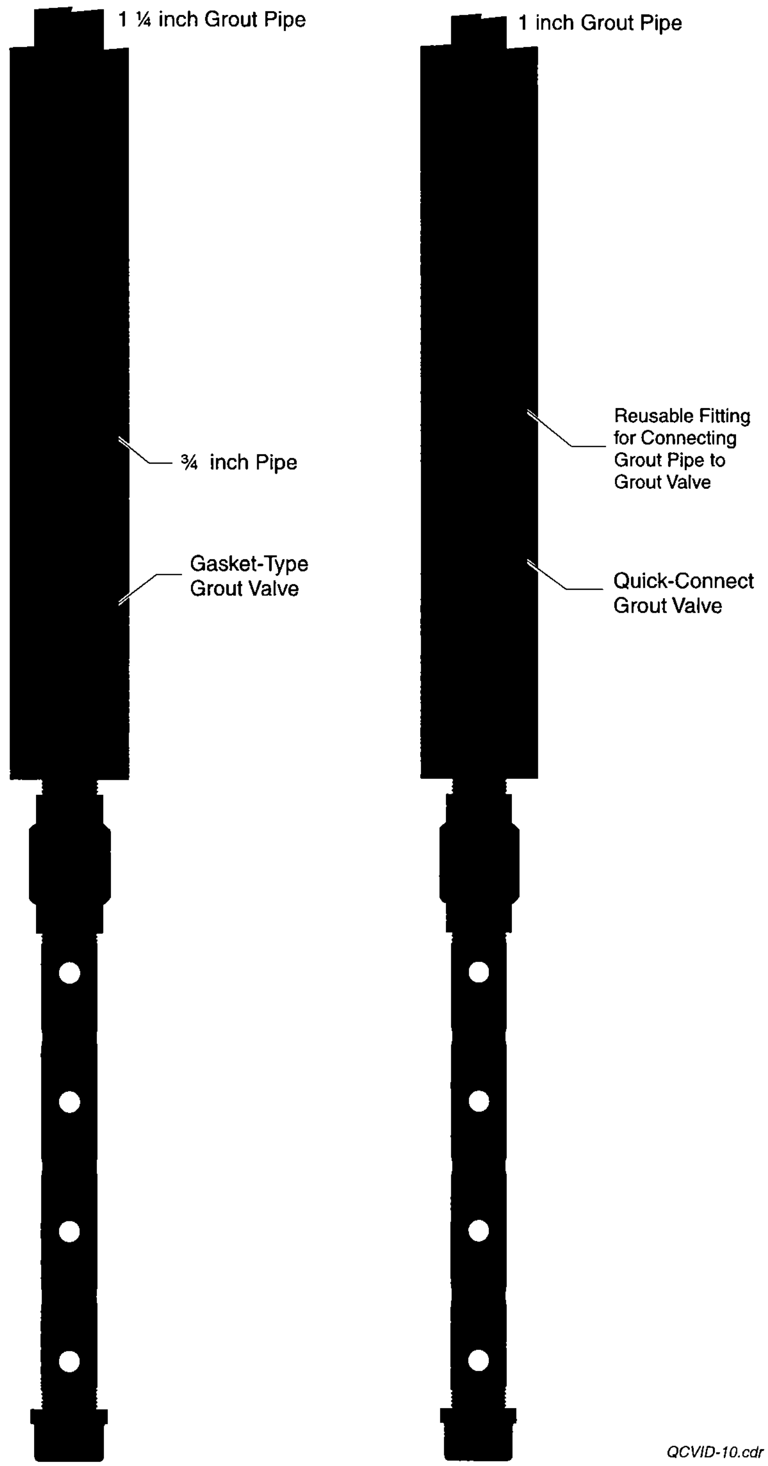
Grout valves add about two feet to the effective length of the casing, so the borehole should be about two feet deeper to compensate.

Types of Grout Valves

Grout valves are illustrated on the next page.

The gasket-type grout valve couples with the grout pipe via a straight pipe with a rubber gasket at its base. The grout pipe is lowered onto the grout valve rest on the gasket. This prevents grout from entering the casing. However, when the grout pipe is withdrawn, grout spills out of the pipe into the casing and must be flushed out with water.

The quick-connect grout valve has a quick connect fitting that mates with another quick-connect fitting that is attached to the grout pipe. When the grout pipe is withdrawn, very little grout leaks into the casing. However, as you are retrieving the pipe, you must be careful not to spill grout into the casing, since you will have to flush it out.


1 ¼ inch Grout Pipe
¾ inch Pipe
Gasket-Type Grout Valve
1 inch Grout Pipe
Reusable Fitting for Connecting Grout Pipe to Grout Valve
Quick-Connect Grout Valve
QCVID-10.cdr

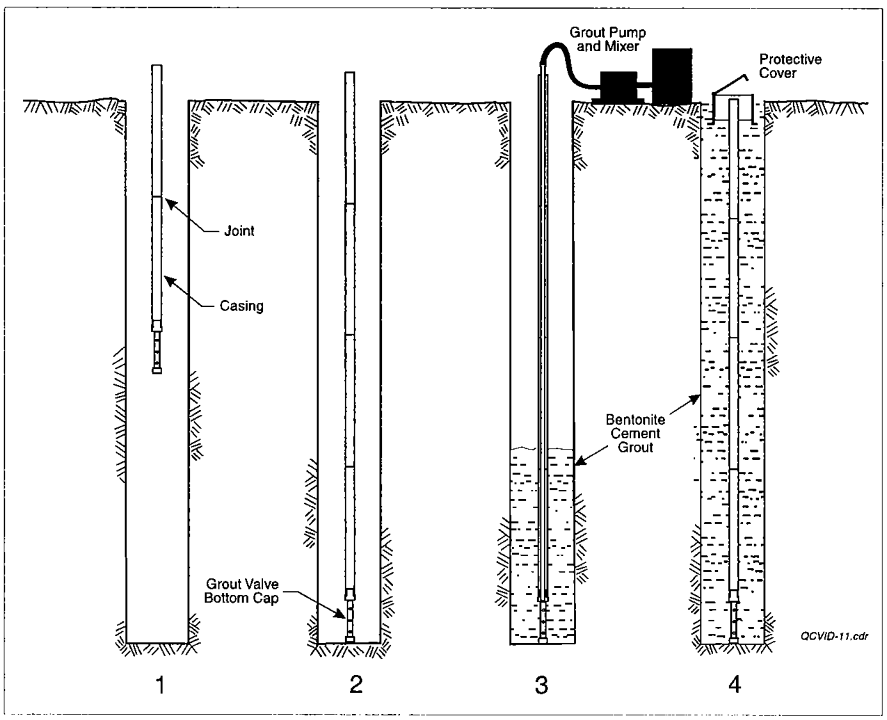
Using a Grout Valve

1. Install grout valve on bottom section of casing. Install casing to the required depth.
2. Lower the grout pipe into the casing until it contacts the grout valve. Rotate the pipe until it slips onto the grout valve connector. Successful coupling can be tested by pumping water through the grout pipe. If the water level inside the casing rises, reposition the pipe and test again.
3. Pump in grout until it spills out at the surface. The weight of the grout pipe will keep the casing from floating. Note: If you installed dry casing, pump water into the casing as the grout level rises.
4. When you retrieve the grout pipe, the casing will float upwards, so you must be prepared to hold the casing down as you retrieve the pipe. Follow either of the two procedures below:
   - **Gasket-type valve:** If you are using the gasket-type grout valve, raise the grout pipe well above the grout valve and pump water into the casing to flush out the grout. When clean water spills out at the surface, gradually lower the pipe and continue to flush until you have flushed grout from the bottom of the casing. Then disconnect the pipe at the surface and leave it in the casing to counteract buoyancy. When the grout sets, withdraw the pipe.

Using a Grout Valve continued

- **Quick-connect valve:** If you are using a quick-connect grout valve, retrieve the grout pipe and flush it with water. Then lower pipe into the casing to counteract buoyancy. You must avoid contact with the quick-connect valve, since it can be opened easily. You can fabricate a bracket that fits over the quick-connect valve (the quick connect fitting stands about 3 inches off the bottom of the casing) or you can use a 1.5-inch schedule 40 water pipe (which has ID of about 1.6 inches), which will slip over the quick-connect valve. After the grout sets, withdraw the pipe.

5. Finally, top off the borehole with grout and install a protective cover.



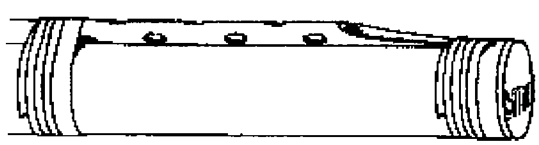
Stage Grouting

In stage grouting, grout backfill is placed in stages, so that the pressure of grout never exceeds the collapse strength of the casing. In general, you should consider stage grouting when the depth of the borehole exceeds 200 feet.

- Grout can be delivered by hose or pipe. Hose must be installed with the casing, but it is disposable and can be left in place after grouting.
- Stage grouting with hoses requires at least two hoses. The first pipe should extend to the bottom of the borehole. The next pipe should extend to bottom of the the next stage, and so on.
- Be sure to label or color-code each grout pipe to avoid accidentally pumping grout or water down the wrong pipe.
- Make some provision to counter buoyancy of the casing. This is best done by applying a down force at the bottom of the casing.

Overview of Stage Grouting with Hoses

1. Hoses are fixed to the casing as shown in the drawing below. In Stage 1, calculate the volume of grout needed to backfill the borehole above the end of the Stage 2 grout hose. Pump in that volume of grout plus about 30%. Leave the Stage 1 grout hose in place.
2. Pump water through the Stage 2 grout hose. The bottom of the Stage 2 hose should be below the surface of the grout, and pumping in water should flush grout from the borehole. If no grout appears, pump more grout through the Stage 1 hose and then test again. Using this method, you can be relatively certain that Stage 1 is grouted
satisfactorily. Continue pumping water through the Stage 2 hose until "clear" water flushes from the borehole. This ensures that the Stage 2 hose will be clear for use later.
3. When the State 1 grout has set, grout Stage 2. Since the bottom of the casing is now grouted in place, buoyancy will no longer be a problem.



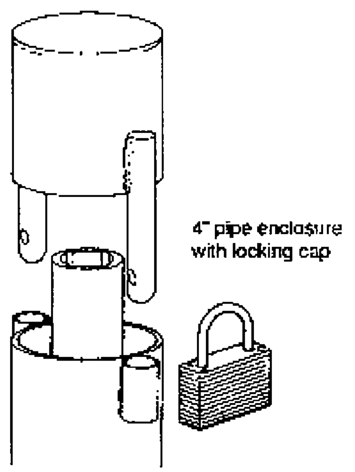
To prepare a polyethylene hose for grouting, cut a wedge-shaped end and several additional holes. Then tape the hose to the casing.

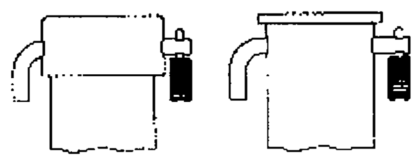
4

Termination

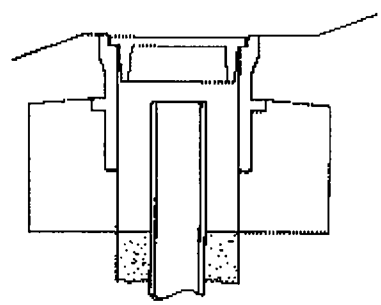
Protective Caps and Enclosures

Project specifications usually require that the installation be protected from traffic, vandalism, and debris. In some locations, a locked cap may provide sufficient protection. In other locations, a locking steel enclosure or a monument case may be required.





Locking Caps



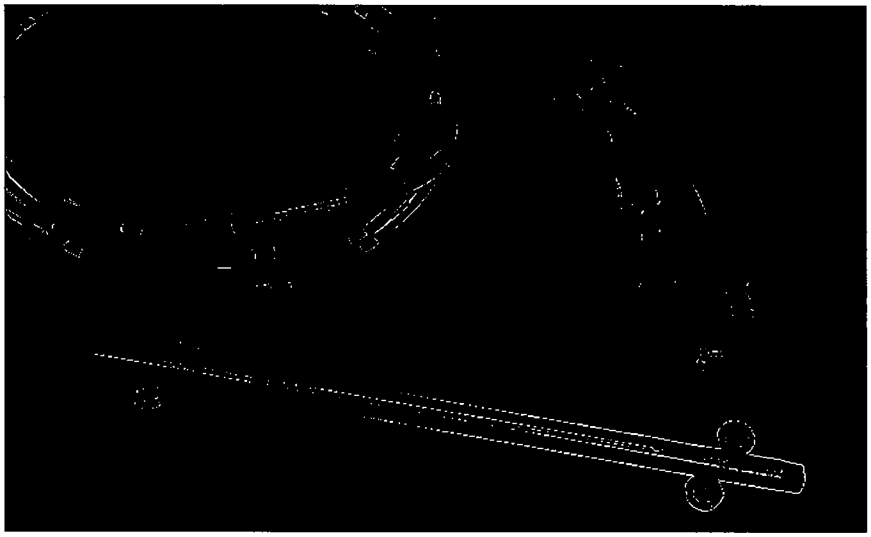
Monument Case

Accommodating a Pulley Assembly

Keep in mind that the inclinometer user will want to attach a pulley assembly to the top of the casing. If the top of the casing is deep inside a protective pipe, the user will not be able to attach the pulley. Ideally, the enclosure should be installed so that the top of the enclosure is only an inch or two above the top of the casing. When the top of the casing is deeper, the enclosure must provide a 10 inch clearance around the casing if the pulley is to be attached directly to the casing.

ATTACHMENT C

Digitilt Inclinometer Probe



Applications

Digitilt® inclinometers are used to monitor subsurface movements of earth in landslide areas and deep excavations. They are also used to monitor deformations in structures such as dams and embankments.

Operation

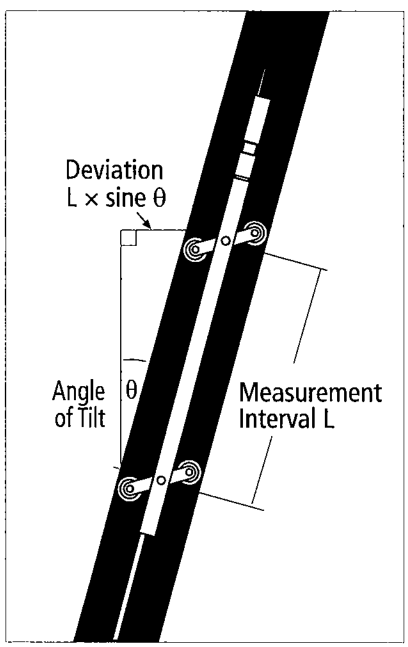
Inclinometer casing is typically installed in a vertical borehole that passes through suspected zones of movement into stable ground. The Digitilt inclinometer probe, control cable, pulley assembly, and readout are used to survey the casing. The first survey establishes the initial profile of the casing. Subsequent surveys reveal changes in the profile if ground movement occurs.

During a survey, the probe is drawn upwards from the bottom of the casing to the top, halted in its travel at 0.5 m or 2' intervals for tilt readings.

The inclination of the probe body is measured by two force-balanced, servo-accelerometers. One accelerometer measures tilt in the plane of the inclinometer wheels, which track the longitudinal grooves of the casing. The other accelerometer measures tilt in the plane perpendicular to the wheels.

Inclination measurements are converted to lateral deviations, as shown in the drawing below. Changes in deviation, determined by comparing current and initial surveys, indicate ground movement.

Plotting changes in deviation yields a high resolution displacement profile. Displacement profiles are useful for determining the magnitude, depth, direction, and rate of ground movement.



Advantages

Proven Performance: Digitilt inclinometer probes have earned a world-wide reputation for durability, high precision, and rapid response.

Repeatable Tracking: To ensure consistent tracking in all types of casing, the probe is equipped with robust wheel carriages, sealed wheel bearings, and specially designed wheels.

Extended Installation Life: The compact size of the Digitilt probe allows it to pass through small radius curves, extending the useful life of the installation beyond that provided by other inclinometer probes.

Computerized Testing: Each probe undergoes thorough testing on a computerized calibration table.

Reliable Control Cable: Digitilt control cable is durable and easy to handle, stays flexible in cold weather, resists chemicals and abrasion, and provides excellent dimensional stability. Flexible rubber depth marks are permanently vulcanized to the cable jacket. The marks cannot loosen and have no rigid edges that can damage the cable jacket and conductors.

Consistent Depth Control: The pulley assembly, a recommended accessory, helps the operator achieve uniform depth control. The one-way action of its cable clamp ensures consistent positioning of the probe.

Complete Solutions: Slope Indicator's inclinometer system includes high-quality casing, vertical and horizontal traversing probes, vertical and horizontal in-place sensors, recording readouts, graphing software, and specialized accessories.

METRIC PROBE SPECIFICATIONS

Wheel base: 500 mm.

Range: ±53° from vertical.

Resolution: 0.02 mm per 500 mm.

Repeatability: ±0.003°.

Calibration: 14 point calibration with NIST traceable calibration device.

Temperature Rating: -20 to +50 °C.

Dimensions: 25.4 x 653 mm. Control cable connector adds 92 mm to length of probe.

Weight: 1.8 kg.

Material: Stainless steel.

ENGLISH PROBE SPECIFICATIONS

Wheel base: 24".

Range: ±35° from vertical.

Resolution: 0.0012 inch per 24 inches.

Repeatability: ±0.003°.

Calibration: 14 point calibration with NIST traceable calibration device.

Temperature Rating: -4 to +122 °F.

Dimensions: 1 x 30". Control cable connector adds 3.75"to length of probe.

Weight: 4 lb.

Material: Stainless steel.

ACCURACY SPECIFICATIONS

Metric Systems: ±0.25 mm per reading, or ±6 mm accumulated over 50 readings.

English Systems: ±0.01 inch per reading, or ±0.3 inch accumulated over 50 readings.

These system accuracy specifications were derived empirically from the analysis of a large number of surveys and include both random and systematic errors introduced by casing, probe, cable, readout, and operator. Casing was installed within 3 degrees of vertical, and operators followed recommended reading practices.

With careful installation of casing, redundant surveys, and corrections for systematic error, system accuracy can be improved to approximately ±1 mm and ±0.05 inch per fifty readings.

DIGITILT INCLINOMETER PROBE

Metric-Unit Probe **50302510**
English-Unit Probe **50302500**

Digitilt inclinometer probe includes a carrying case and instruction manual. Control cable, pulley, and readout are not included.

CONTROL CABLE

30m Control Cable, Complete ... **50601030**
50m Control Cable, Complete ... **50601050**
100m Control Cable, Complete .. **50601100**

100 ft Control Cable, Complete .. **50601002**
150 ft Control Cable, Complete .. **50601003**
300 ft Control Cable, Complete .. **50601004**

Metric Cable, Custom Length.... **50601010**
English Cable, Custom Length ... **50601000**
Connector for Readout **50301800**
Connector for Probe........... **50303100**

Control cables listed as complete are standard lengths of cable and include connectors. If you order a custom length cable, you must also order connectors.

Control cable is supplied with no splices or surface defects and has a rated strength of 480 lb and a working strength of 120 lb.

Metric cable is graduated with yellow 0.5-meter marks and red 1-meter marks. English cable is graduated with yellow 2-foot marks and red 10-foot marks.

Cable has a steel core wire to control stretching, a torsion braid to counter cable torque, a binder layer to eliminate slipping of cable jacket relative to the steel core, and depth marks that are vulcanized onto the cable jacket. The Neoprene cable jacket resists chemicals and abrasions and is flexible in cold temperatures.

Reels used to store cable should have hubs with a diameter of eight inches or more. Power reels should have hub diameter of sixteen inches.

PULLEY ASSEMBLY

Small Pulley **51104604**
Large Pulley **51104606**

Pulley assembly clamps onto top of casing to help operator control depth of probe. Cable clamp serves as reference for depth marks. Removable pulley wheel facilitates insertion of probe into casing.

Use small pulley with 48 or 70 mm (1.9 or 2.75") casing. Use large pulley with 70 or 85mm (2.75 or 3.34") casing.

READOUTS

Digitilt DataMate **50310900**

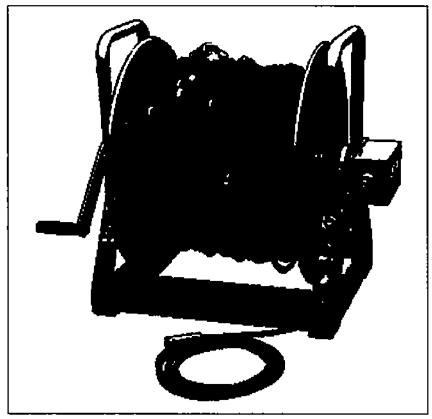
The Digitilt DataMate is a recording readout. The Digitilt 09 is a manual readout. See separate data sheets for details.

DUMMY PROBE

Metric Wheel Base **50304810**
English Wheel Base............ **50304800**
Reel & Line for Dummy Probe.... **50304900**

Dummy probe is used to test for casing continuity, groove continuity, and obstructions or severe distortions of casing that could hinder retrieval of Digitilt probe and control cable. Dummy probe is stainless steel and has dimensions and wheels identical to those of Digitilt probe.

Reel with 60 m (200') of nylon line is used to lower and retrieve dummy probe.



Slip-Ring Cable Reel

SLIP-RING REELS

200 m (650') capacity **50503100**
300 m (1150') capacity **50503300**

Sturdy slip-ring cable reel allows the readout to remain connected while the reel is operated. Jumper cable, included, connects readout to reel.

STORAGE REELS

50 m (164') capacity **50502050**
100 m (360') capacity **50502110**

Sturdy storage reel with large diameter hub keeps cable neat when not in use.

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Digitilt Inclinometer Probe 50302599

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Contents

Introduction

Inclinometer System

An inclinometer system includes inclinometer casing, an inclinometer probe and control cable, and an inclinometer readout unit.

Inclinometer casing is typically installed in a near-vertical borehole that passes through a zone of suspected movement. The bottom of the casing is anchored in stable ground.

The inclinometer probe is used to survey the casing and establish its initial position. Ground movement causes the casing to move away from its initial position. The rate, depth, and magnitude of this movement is calculated by comparing data from the initial survey to data from subsequent surveys.

This Manual

This manual addresses the use and maintenance of the inclinometer probe and control cable. It also provides an overview of taking readings and reducing data.

Other manuals cover casing installation, inclinometer readouts, and software for reducing data.

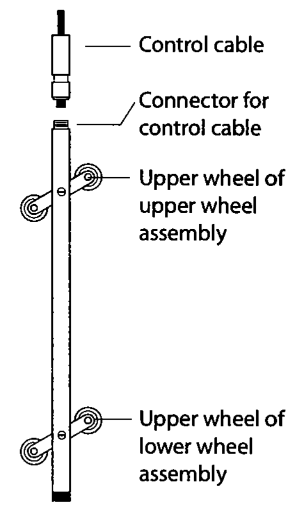
The Inclinometer Probe

Parts of the Probe

The inclinometer probe consists of a stainless steel body, a connector for control cable, and two pivoting wheel assemblies.

When properly connected to the control cable, the probe is waterproof and has been used deeper than 1000 feet.

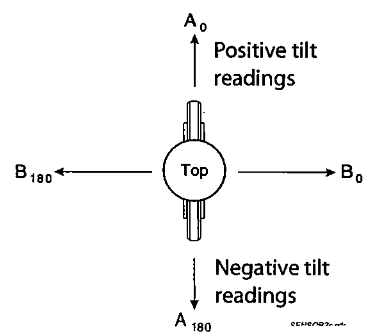
The wheel assemblies consists of a yoke and two wheels. One of the wheels in each assembly is higher than the other. This wheel is called the "upper wheel" and has special significance, as explained below.



Measurement Planes

The inclinometer probe employs two force-balanced servo-accelerometers to measure tilt. One accelerometer measures tilt in the plane of the inclinometer wheels. This is the "A"axis. The other accelerometer measures tilt in the plane that is perpendicular to the wheels. This is the "B" axis.

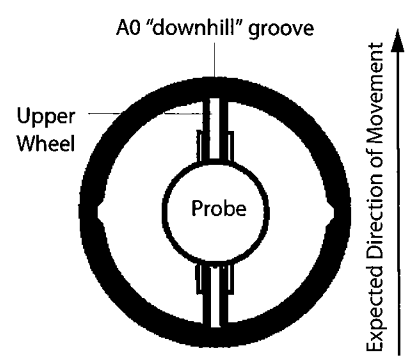
The drawing at right shows the probe from the top. When the probe is tilted toward the A0 or B0 direction, readings are positive. When the probe is tilted in the A180 or B180 directions, readings are negative.



Orientation of the Probe

Inclinometer casing is installed so that one set of grooves is aligned with the expected direction of movement. One groove, typically the "downhill" groove should be marked A0.

In a standard inclinometer survey, the probe is drawn from the bottom to the top of the casing two times. In the first pass, the upper wheels of the probe should be inserted into the A0 groove. This ensures that movements are positive values.



Always start surveys with upper wheel in A0 groove.

Handling the Probe

The inclinometer probe is a sensitive measuring instrument. Handle it with care.

- Transport the probe in its carrying case. If you drive to the site, carry the casing in the passenger compartment, preferrably on a passenger seat.
- When you connect control cable to the probe, avoid overtightening the nut, since this will flatten the O-ring and reduce its effectiveness.
- Before you lower the probe into the casing, turn the power on.
- When you insert the probe into the casing, cup the wheels with your hands to compress the springs and allow smooth insertion.
- When you lower the probe into the borehole, do not allow it to strike the bottom.
- When you withdraw the probe from the casing, again cup the wheels with your hands to prevent them from snapping out.
- When you rotate the probe, keep it upright and perform the rotation smoothly.
- The probe is rated for temperatures from -20 to 50 °C (-4 to 122 °F). Avoid using the probe in temperatures outside this range.

Caring for the Probe

This is an overview. See the last chapter, Inspection and Maintenance, for additional information.

Cleaning the Probe: When you finish a survey, wipe moisture off the probe and replace the protective cap. If necessary, rinse the probe in clean water or wash it with a laboratory grade detergent when you return to the office.

Cleaning the Connectors: Do not clean connectors with spray lubricants or electrical contact cleaners. Solvents in these products will attack the neoprene inside the connector. When it is necessary to clean the connectors, use a cotton swab slightly moistened with alcohol. Be careful to use only a small amount of alcohol.

Drying the Probe: When you return to the office, remove protective caps from the control cable, probe, and readout unit. Allow connectors to air-dry thoroughly for a number of hours. Afterwards, replace the caps.

Storing the Probe: The probe, control cable, and readout unit should be stored in a dry place. For extended storage, keep the probe in a vertical position.

Lubricating the Wheels: Lubricate the wheels regularly. Spray a small amount of lubricant or place a drop of oil on both sides of the wheel bearings. Check that the wheels turn smoothly.

O-Ring Care: Periodically clean and lubricate the O-ring on the connector end of the inclinometer probe. Use O-ring lubricant.

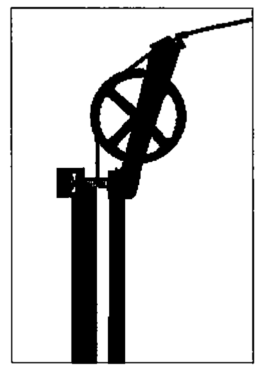
Control Cable

Introduction

Control cable is used to control the depth of the inclinometer probe. It also conducts power to the probe and returns signals to the readout.

- Metric control cables are graduated with yellow marks at 0.5 meter intervals and red marks at 1-meter intervals. There are numeric marks at 5-meter intervals.
- English control cables are graduated with yellow markers at 2-foot intervals and red marks at 5-foot intervals. There are numeric marks at 50-foot intervals. In addition, there are yellow bands of tape at 10 foot intervals. Each band represents 10 feet from the last numeric mark. For example, 4 bands represent 40 feet from the last numeric depth mark.

Depth Control



Accurate inclinometer measurements depend on consistent placement of the inclinometer probe. Always align the depth marks on the control cable with the same reference. Aim for placement repeatability of 6 mm (1/4 inch) or better.

We recommend using a pulley assembly to assist with depth control. The jam cleat on the pulley assembly holds the cable and the top edge of the chassis provides a convenient reference for cable depth marks.

The small pulley assembly is used with 48 mm and 70 mm casing (1.9 and 2.75 inch). The large pulley assembly is used with 70 mm and 85 mm casing (2.75 and 3.34 inch).

Using the Pulley Assembly

1. Remove the pulley from the chassis.
2. Clamp the chassis to the top of the casing.
3. Insert the inclinometer probe and control cable.
4. Replace the pulley.

Note: The distance between the top edge of the pulley chassis and the top of the casing is one foot. Your data reduction software can automatically adjust for this, so keep your survey procedure simple: use the marks on the cable and the top edge of the pulley chassis for reference. Let the software do any extra work required.

Check that operators consistently use the pulley assembly. If the pulley is used for one survey and not for the next, the resulting data sets will not be directly comparable. Sometimes a monument case or a protective pipe makes it impossible to attach the pulley assembly to the casing. In this case, you can make a removable adapter for the pulley assembly. If you use an adapter, be sure to use it consistently.

Cable Tips

Connecting Cable: When you connect control cable to the probe, avoid overtightening the nut, since this will flatten the O-ring and reduce its effectiveness.

Calibrate your Cable: If you have time, "calibrate" your cable, recording the exact position of cable marks. This can be important for long term monitoring projects.

Caring for Cable

Cleaning the cable: If necessary, rinse the cable in clean water or wash the cable in a laboratory-grade detergent, such as Liquinox.® Do not use solvents to clean the cable. Be sure the protective cap is in place before immersing the end of the cable in water. Do not immerse the Lemo connector.

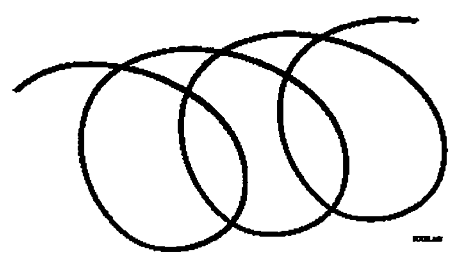
Cleaning Connectors: If it is necessary to clean the connector, use a cotton swab moistened with a small amount of alcohol. Do not use spray lubricants or electric contact cleaners. Solvents contained in such products will attack the neoprene inserts in the connectors.

Drying Connectors: When you return to the office, remove protective caps from the control cable, probe, and readout unit. Allow connectors to air-dry well for a number of hours.

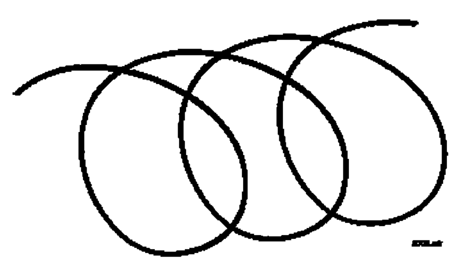
Storage: Store cable on a cable reel when possible. The reel should have a minimum hub diameter of 300 mm (12 inches). If a reel is not available, use the technique below to coil the cable.

Coiling Cable

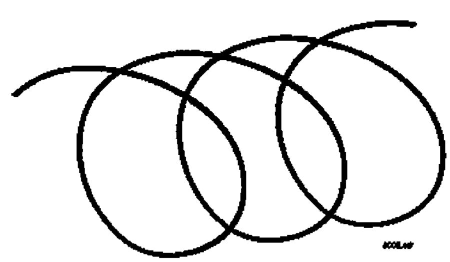
1. Loop cable forward as shown in drawing.



2. Twist cable backwards to make a second loop as shown in drawing.



3. Continue coiling cable, alternating loops as in steps 1 and 2.



Taking Readings

Good Practices

- Use the same probe and control cable for each survey, if possible.
- Use a pulley assembly, if possible. It protects the control cable and provides a good reference.
- Use a consistent top reference. The goal is placement repeatability within 5 mm or 1/4 inch. If one technician uses a pulley and another technician does not, probe positioning will be inconsistent, and data will have to be manipulated before it is useful.
- Always draw the probe upward to the reading depth. If you accidentally draw the probe above the intended depth, lower the probe down to the previous depth, then draw it back up to the intended depth. This technique ensures the probe will be positioned consistently.
- Wait 10 minutes for the probe to adjust to the temperature of the borehole.
- Wait for displayed readings to stabilize as much as possible. If the readings do not stabilize, try to record an average reading.

Setting Up

1. When you arrive at the site, lay out a plastic sheet or tarp to set the equipment on. You should have the inclinometer probe, the indicator, the control cable, and the pulley assembly. Some people find it is useful to bring a basket or box to hold the control cable and a rag to wipe off the probe and cable after readings have been taken.
2. Unlock and remove the protective cap from the casing. Attach the pulley assembly.
3. Remove protective caps from probe and control cable.
4. Align the connector key with the keyway in the probe. Then insert the connector and tighten the nut to secure the connection. Do not over-tighten the nut, since this will flatten the O-ring and reduce its effectiveness.

Position the Probe

1. Turn on the indicator. This energizes the accelerometers, making them less susceptible to shock.
2. Insert the probe into the casing with the upper wheels of both wheel assemblies in the A0 groove. (Cup the wheels with your hands to compress the springs for a smooth insertion). If you are using the pulley assembly, take out the pulley wheel, insert the probe, and then replace the wheel.
3. Lower the probe slowly to the bottom. Do not allow it to strike the bottom. Allow the probe to adjust to the temperature inside the casing. Five or ten minutes is usually sufficient.

Record Data

1. Raise the probe to the starting depth. Wait for the numbers on the readout to stabilize. If you are using the DataMate, press the button to record both the A and B axis readings. If you are using a manual indicator, write down the A-axis reading, then switch to the B-axis and record that reading.
2. Raise the probe to the next depth. Wait for a stable reading, and then record it. Repeat this process until the probe is at the top of the casing.
3. Remove the probe and rotate it 180 degrees, so that the lower wheels of both wheel assemblies are inserted into the A0 groove. When you remove the probe, cup the wheels with your hands to prevent them from snapping outwards. Also, hold the probe upright when rotating it.
4. Lower the probe to the bottom, raise it to the starting depth, and continue the survey. Take readings at each depth until you have reached the top. Remove the probe. At this point, you may want to validate the data set and make any corrections necessary.

Leaving the Site

Wipe off the probe and cable. Replace end-caps on cable and probe and return the probe to its protective case. Replace the indicator's protective plugs. Coil the cable. Remove the pulley assembly and replace and lock the protective cap.

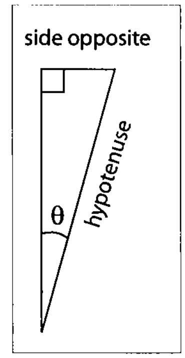
At the Office

Wipe off the indicator and recharge its batteries. Transfer the data set to a PC. Oil the probe wheels. If the storage place is dry, remove protective caps from probe, indicator, and control cable to allow all connectors to dry.

Data Reduction

Inclinometer Measurements

The inclinometer probe measures tilt, rather than lateral movement. How does tilt provide information about lateral movement? The basic principle involves the sine function, an angle, and the hypotenuse of a right triangle. We are interested in the length of the side opposite the angle θ.

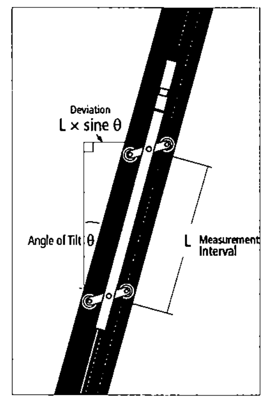


$$\sin\theta = \frac{\text{side opposite}}{\text{hypotenuse}}$$

$$\text{side opposite} = \text{hypotenuse} \times \sin\theta$$

Deviation

In the drawing at right, the hypotenuse of the right triangle is the measurement interval. The measurement interval is typically 0.5 m with metric-unit inclinometers or 2 feet with English-unit inclinometers.

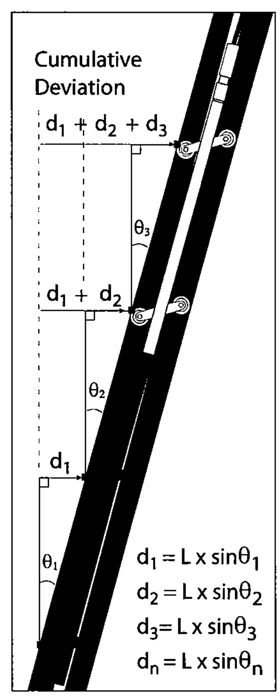


The side opposite the angle of tilt is deviation. It is calculated by multiplying the sine of the angle of tilt by the measurement interval. This calculation translates the angular measurement into a lateral distance and is the first step to calculating lateral movement.

Cumulative Deviation

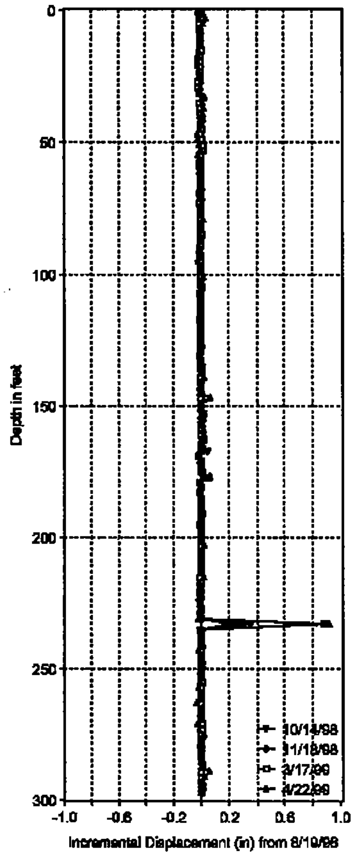
By summing and plotting the deviation values obtained at each measurement interval, we can see the profile of the casing.

The black squares at each measurement interval represent cumulative deviation values that would be plotted to show the profile of the casing.

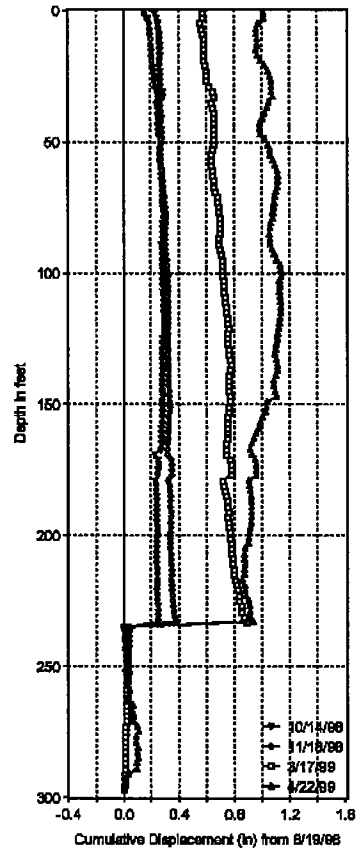


Displacements

Changes in deviation are called displacements, since the change indicates that the casing has moved away from its original position. When displacements are summed and plotted, the result is a high resolution representation of movement.



Incremental displacement plot shows movement at each measurement interval. The growing "spike indicates a shear movement.



Cumulative displacement plot shows a displacement profile. Displacements are summed from bottom to top.

Reducing Data Manually

Normally, computer software is used to reduce inclinometer data. Here, we show only a simple overview.

Displayed Readings

Slope Indicator's readouts display "reading units" rather than angles or deviation. Reading units are defined below:

$$\text{Displayed Reading} = \sin\theta \times \text{Instrument Constant}$$

$$\text{Reading}_{\text{English}} = \sin\theta \times 20{,}000$$

$$\text{Reading}_{\text{Metric}} = \sin\theta \times 25{,}000$$

Combining Readings

The standard two-pass survey provides two readings per axis for each interval. The probe is oriented in the "0" direction for the first reading and in the "180" direction for the second reading. This two-pass system has several advantages. First, it eliminates the sensor offset, which can change from survey to survey. Second, it provides a means of detecting error through checksums and other routines. Third, it tends to smooth the effect of random errors. At some point during data reduction, the two readings are combined and averaged. For example:

$$\text{A0 Reading} = 359 \qquad \text{A180 Reading} = -339$$

$$\text{Averaged Reading} = \frac{359 - (-339)}{2} = 349$$

Calculating Deviation

To calculate lateral deviation, we average the A0 and A180 readings, divide by the instrument constant, and multiply by the measurement interval. In the example below, we show an English-unit calculation:

$$\text{Lateral Deviation} = \text{Measurement Interval x } \sin\theta$$

$$24 \text{ inches} \times \frac{359 - (-339)}{2 \times 20,000}$$

$$= 0.4188 \text{ inches}$$

Combine the A0 & 180 readings and divide by 2 to average them.

Divide reading unit by instrument constant to obtain sine of angle.

Calculating Displacement

Displacement, the change in lateral deviation, indicates movement of the casing. To calculate displacement, we find the change in (combined and averaged) reading units, divide by the instrument constant, and multiply by the length of the measurement interval.

$$\text{Combined Reading}_{\text{current}} = 700 \qquad \text{Combined Reading}_{\text{initial}} = 698$$

$$\text{Displacement} = \text{Measurement Interval} \times \Delta\sin\theta$$

$$= 24 \text{ inches} \times \frac{700 - 698}{2 \times 20,000}$$

$$= 0.0012 \text{ inches}$$

Calculating Checksums

A checksum is the sum of a "0" reading and a "180" reading at the same depth.

A0 reading = 359   A180 reading = -339

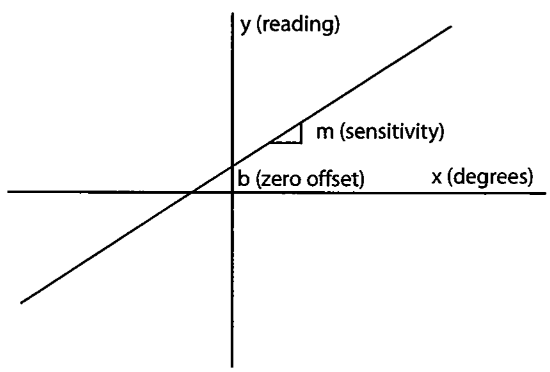
Checksum = 359 + (-339)

= 20

Bias (zero offset)

If you hold your inclinometer probe absolutely vertical and check the reading, you will typically see a non-zero value for each axis. The non-zero value is the result of a slight bias in the output of the accelerometers. The bias (or zero offset) may be negative or positive and will change over the life of the probe. This is not normally a matter for concern, because the zero offset is effectively eliminated by the standard two-pass survey and the data reduction procedure.

Below, we show an readings that have a zero offset of 10. During the first pass the probe measures a tilt of 1 degree. During the second pass the probe measures a tilt of -1 degree, because it has been rotated 180 degrees. See how the offset increases the positive reading and decreases the negative reading, even though the measured angle has not changed. However, when the two readings are combined, as discussed in "Combining Readings" above, the offset is eliminated and the correct value emerges.



Tilt angle = 1 degree.   Theoretical reading unit = 349   (20,000 x sin (1))

Offset = 10

Displayed A0 reading = 359   (349 + 10)

Displayed A180 reading = -339   (-349 + 10)

Combined reading = 698   (359 - (-339))

Averaged reading = 349

Inspection & Maintenance

Probe Inspection

Part	What to check for	Remedy
Wheel yoke	Side to side movement	Check pivot pin, which looks like screw. If pivot pin has been turned too far, it may spread the wheel yoke. Turn the pivot pin counter-clockwise to see if movement disappears. If movement persists, replace the nylon spacers or the entire wheel assembly. The wheel assembly can be replaced by the user: kit number 50302555.
Wheel yoke	Yoke does not return to fully extended position.	If yoke is dirty, clean it. If problem persists, spring may be broken or weak. Replace spring and roll pins or replace wheel assembly using kit 50302555.
Wheel	Side to side movement	Bad bearing. Replace wheel assembly.
Wheel	Does not turn freely	Lubricate. If movement is still bad, replace wheel assembly.
Body screws	Loose screws, wobble in body, loose bumper	Tighten screws. (Do not tighten pivot pin).
Connector keyways	Wear, corrosion	Worn keyway may degrade O-ring seal. Learn how to connect cable without "hunting." Remove corrosion and change practice - allow connector to dry after use.
Connector O-ring	Flattened, split	Replace if flattened or split.
Connector pins	Bent pins	Bent pins are easily broken when straightened. Replacement of connector requires recuperation of probe (expensive). Change connection practice - no hunting.

Probe Maintenance

Moisture Management	Wipe off the control cable and probe when you finish the day's final survey, then wipe off the probe. Do not store wet cloth with the probe. Allow the connector to dry thoroughly: remove connector cap and allow connector to air-dry for a number of hours. Lubricate the wheels. This helps displace moisture.
Wheels	Lubricate the wheels by spraying a small amount of lubricant or placing drops of oil on both sides of the wheel bearings.
O-Ring	Lubricate regularly with O-ring lube or silicone based grease. Do *not* use WD-40 or any other lubricant spray that contains chlorinated solvents.
Connectors	Clean connectors as necessary. Use a slim cotton swab moistened with alcohol. Be careful not to bend pins. Do not use electrical contact cleaners, especially sprays. Solvents in these products will attack the neoprene inside the connectors. When attacked, the neoprene swells and reduces the effectiveness of the O-ring seal.
Storage	Store probe in dry place. Be sure that the box is dry, the wheels are oiled, the connector is dry. If probe is to be stored for an extended period, stand it vertically.

Control Cable Inspection

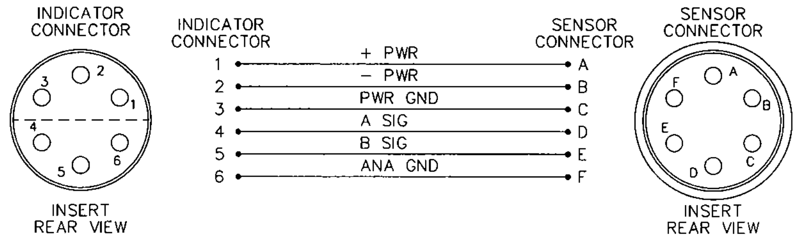
Part	What to check for	Remedy
Cable	Continuity	If you have intermittent failures, perform continuity tests. If a wire fails continuity test, you can check the Lemo connector or return cable for servicing or replacement.
Cable	Twists, worn markings, kinks, gouges	Twists indicate poor coiling technique. Change practice: use cable reel, figure-8 coils, or over-under coils. Worn markings: user is dragging cable over the edge of the casing. Change practice - but must keep consistent depths. Kinks: if kinks do not straighten, there is probably internal damage and likelihood of intermittent reading failures. If any deep gouges, water can enter cable. In both cases, bad section of cable must be removed, either by shortening the cable or replacing the cable.
Connector key	Wear, corrosion	Change connection practice - no hunting. Remove corrosion and change practice - allow connector to dry after use.
Connector rubber insert	Swelling, poor seal	Rubber swells when attacked by WD-40 or contact cleaners. Swelling may prevent good seal and allow water to enter connector. Return for service if sealing is compromised.
Connector for Indicator (Lemo)	Corrosion, bad connection.	Perform continuity check first. Then check this connector to eliminate as possible source of intermittent failures. Unscrew bottom nut, being careful not to twist cable. Slide shell off the end of the cable. Slide strain relief collet out of the way and inspect connections. Twist and pull wires gently. Good connections will not break. Repair as necessary.
Connector for Probe	Check O-ring	Do *not* disassemble this connector. Requires about two hours and a pressure test to reassemble.

Control Cable Maintenance

Moisture Management	Wipe off the control cable as you draw the probe up on the last run of the day. When you return to the office, remove connector caps and allow connectors to air-dry for a number of hours.
Cable	When necessary, rinse cable (but not connectors) in clean water or wash the cable in a laboratory-grade detergent, such as Liquinox. Do not use solvents to clean the cable.
Connectors	If it is necessary to clean the connector, use a cotton swab moistened with alcohol. Sockets can be cleaned with a brush. Do not use spray lubricants or electric contact cleaners. Solvents contained in such products will attack the neoprene inserts in the connectors.
Storing Control Cable	Improper coiling of any electrical cable twists conductors and can cause reliability problems. There are several ways to control twisting: • Use cable reel with hub diameter of at least 200mm or 8". • Coil cable in a figure-8. • Coil cable using over-under loops (2-foot diameter loops).

Control Cable Connectors

Below is the wiring diagram for the connectors on the control cable.



Testing

Connectors are made to mate with each other but not with any other objects. Never insert the probe of your multimeter into a socket. In making the measurements below, simply touch the probe to the top of the socket.

Continuity Test: Pin 1 to Pin A, Pin 2 to Pin B, etc, should measure a little less than 1 ohm per 30 m (100 feet).

Isolation Test: Pin to pin should measure infinity. Also any pin to the body of the connector should measure infinity.

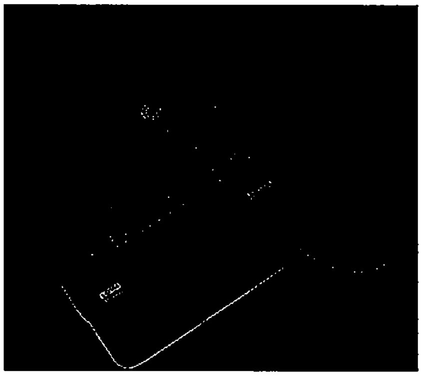
Servicing

Use caution when attempting to service either connector.

The Lemo connector on the indicator end of the cable is easier to service. When you disassemble the connector, be sure that you do not twist the cables.

The heavy connector on the sensor (probe) end of the cable is more difficult to service. We recommend that you send it to the factory unless you are experienced and are willing to spend some time working with it.

Digitilt DataMate



Simple to operate, the compact Digitilt DataMate runs 16 hours, stores up to 40 surveys, and transfers data to a PC for processing. Electronics have been updated to provide significantly faster operation.

The Digitilt DataMate

The Digitilt DataMate records data from inclinometer probes, tiltmeters, and spiral sensors. It stores up to 40 complete inclinometer surveys and powers a Digitilt inclinometer probe for 16 hours.

The DataMate is designed for hard use in difficult environments. Electronic components are rated for extended temperatures. Connector sockets are located on the face panel, away from contact with mud, water, or snow. The case is sealed against humidity, and the bright, backlit display is visible under all lighting conditions.

Recording Surveys

The Digitilt DataMate keeps a list of inclinometer installations in its memory. To begin a survey, the operator selects an installation from the list.

The DataMate then displays the starting depth for that installation, and the operator positions the probe at that depth.

The display shows the depth, the A-axis reading, and the B-axis reading. When both readings are stable and ready to record, the DataMate displays a graphic "ready" signal, and the operator uses the hand switch or the keypad to record the readings.

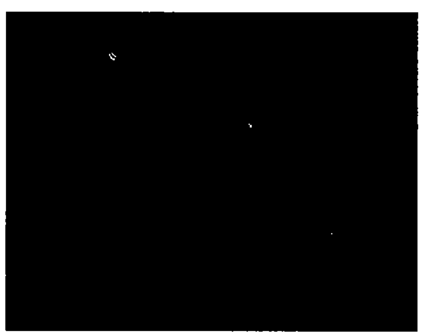
The DataMate beeps to confirm that the readings were recorded and then displays the next depth. The operator raises the probe to this depth, waits for the ready signal, and then records the readings, repeating these steps until the probe reaches the top of the casing. The DataMate then prompts the operator to rotate the probe 180 degrees and begin the second pass through the casing.

The operator can correct a mistake at any time by simply scrolling through the data to any depth, repositioning the probe, and continuing the survey from that point.

Validating Surveys

The DataMate provides checksum statistics to help the operator validate the survey. By comparing the mean and standard deviation of checksums for the current survey with those of previous surveys, the operator can be confident that the data are good.

The DataMate provides routines to help the operator identify questionable readings, which can then be corrected by repositioning the probe. The DataMate displays "live" and recorded readings side by side for comparison, and the operator can overwrite the recorded reading with the live reading, if appropriate.



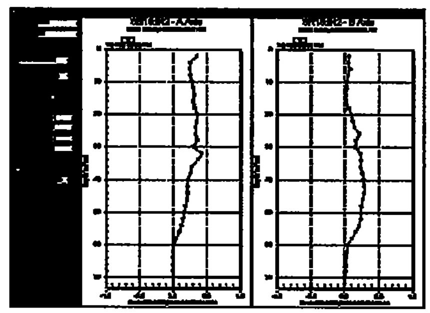
Convenient hand switch reduces fatigue and lets you keep the DataMate clear of the work area.

Retrieving Surveys

Returning to the office, the operator connects the DataMate to the PC's serial port and runs the DataMate Manager program (DMM). DMM retrieves the recorded surveys and stores them in a database for easy access. DMM can also save surveys to ASCII files.

Processing Surveys

Slope Indicator inclinometer software eliminates repetitive work, ensures that calculations are performed accurately, and dramatically reduces the time required to process data.



DMM for Windows software lets you retrieve surveys and produce reports containing readings and graphics.

The DMM program, included with the Digitilt DataMate, can print reports containing inclinometer readings, checksum statistics, and simple graphs of cumulative displacement or cumulative deviation. It also provides routines for settlement correction, spiral dataset expansion, and bias shift analysis.

DigiPro for Windows is an optional graphing program that provides additional types of graphs, including some diagnostic plots, and a number of sophisticated correction routines. A trial version is available for download from the Slope Indicator web site.

DIGITILT DATAMATE READOUT

Digitilt DataMate 50310900

The Digitilt DataMate is a portable readout for Digitilt sensors. It provides depth prompts and stores readings in memory for transfer to a PC. Includes hand switch, battery charger, interface cable for PC, and CD with DMM for Windows and manual. Specify 100, 115, 220, or 240 volts and 50 or 60Hz for charger. DigiPro software is not included.

Sensor Compatibility: Works with English and metric versions of vertical and horizontal inclinometer probes, tiltmeters, and spiral sensors.

Displayed Units: Metric indicator displays readings as 25000 x the sine of the angle of tilt. English indicator displays readings as 20000 x the sine of the angle of tilt.

Survey Types: 2-pass survey for inclinometer probes; 4-pass survey for spiral sensors.

Memory Capacity: Holds a list of 40 installations. Stores up to 40 surveys (biaxial data from 2 passes of 2,500 depths - or 10,000 readings).

Maximum Survey Depth: 500 m or 2000 feet.

Reading Intervals: Fixed intervals. Minimum interval is 0.5 m with metric probe or 1 foot with English-unit probes.

Menu-Selected Functions

Record: Prompts operator with starting depth. Displays A and B axis readings. Displays ready signal when readings are stable. Displays next depth after readings are recorded.

Manual Read: Allows use of DataMate when memory is full or depth display is not required.

Validate: Calculates checksum statistics.

Correct: Allows user to correct mistakes.

Compare: Calculates a single value for cumulative deviation or cumulative displacement.

Comm: For communication with PC.

Print: Outputs ASCII data to a terminal program running on a non-DOS/Windows computer.

Operating Time: 16 hours @ 20°C (68°F) of continuous power to probe. Backup battery preserves data for six months.

Temperature Rating: -20 to 50°C (-4 to 122°F).

Display: 20 x 2 backlit LCD rated for extended temperatures.

Battery: 6 volt, 6 Ah, gelled electrolyte, lead-acid battery. Recharges to 80% capacity in 16 hours using the included charger.

Case: Splashproof, non-submersible, aluminum case with plastic shell. Connectors are waterproof when capped or in use.

Dimensions: 127 x 178 x 178 mm (5 x 7 x 7").

Weight: 3 kg (6.5 lb).

DMM FOR WINDOWS

DMM for Windows. 50310970

The DataMate Manager program (DMM) transfers readings from Digitilt DataMate to a PC. DMM also processes, plots, and prints reports.

DMM is supplied on a Resource CD with the purchase of the Digitilt DataMate and can be downloaded free from www.slopeindicator.com.

System Requirements: Windows computer with RS232 serial port for communication with DataMate. If not serial port is available, a USB to serial adaptor is required.

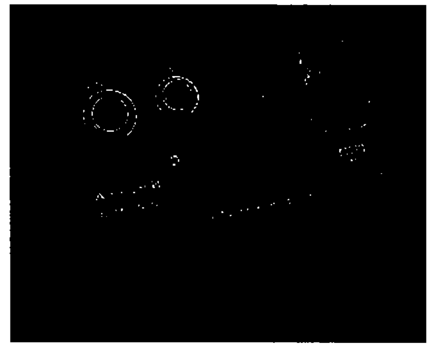
Data Retrieval: DMM communicates with DataMate through RS232 serial connection. Retrieved readings can be stored in a database or in ASCII files.

Data Storage: Surveys retrieved from DataMate are stored in an MDB database. DMM supports drag-and-drop operations between databases and provides easy functions for editing, renaming, moving, and archiving installations and surveys. Surveys retrieved from the DataMate can also be saved as ASCII files.

Data Manipulation: DMM provides a settlement correction routine and a spiral set expansion routine. Both routines generate new surveys.

Import Capabilities: DMM imports legacy data from Slope Indicator's previous formats and from GTILT®. The program also allows manual entry of data.

Report Capabilities: DMM prints inclinometer readings with checksums, compares two surveys (typically current vs initial) to generate A and B-axis graphs of cumulative displacement. The program generates graphs of cumulative deviation. Graphs are displayed on screen and can be printed in a report. Reports can also include checksum statistics, bias-shift analysis tables, and tabular data in digi units (differences and changes).



DIGITILT 09 INDICATOR

Digitilt 09, Metric 50300910
Digitilt 09, English 50300900

The Digitilt 09 Indicator is a portable readout for Digitilt sensors. It displays readings, but does not record them. The user must keep track of depths and readings on a field data sheet. A battery charge is included. Please specify 100, 115, 220, or 240 volt and 50 or 60Hz.

Compatibility: Digitilt inclinometer probes, Digitilt tiltmeters, and spiral sensors.

Displayed Units: Metric indicator displays readings as 2.5 x the sine of the angle of tilt. English indicator displays readings as 2 x the sine of the angle of tilt.

Readings can be entered into the DMM for Windows database and graphed with DigiPro for Windows. If you chose to do this, write down readings without the displayed decimal point and enter the readings as integers.

Resolution: Metric indicator provides resolution of 1 in 25,000. English indicator provides resolution of 1 in 20,000.

Display: Large, backlit 4.5 digit LCD with heater for cold weather operation.

Battery: Rechargeable 6 volt, 6 Ah gelled electrolyte, lead-acid battery. Battery life is 12 hours with fully changed battery. LCD heater reduces operating tim up to 50% when temperature is below 5° C (40° F).

Temperature Rating: -20 to 50°C (-4 to 122°F).

Dimensions: 127 x 178 x 178 mm (5 x 7 x 7").

Weight: 3.4 kg (7.5 lb).

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Digitilt DataMate

50310999

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Contents

Digitilt DataMate

What is the DataMate?

The Digitilt DataMate is a recording readout that is used with Digitilt inclinometer probes (vertical or horizontal), Digitilt tiltmeters, and the spiral sensor. It works with both metric and English unit versions of these sensors.

Readings stored in the DataMate are transferred to a PC using the DMM software supplied with the DataMate. The use of DMM is discussed in a separate manual: DMM for Windows.

DataMate Controls

Power Switch

When you switch power on, the DataMate displays a copyright notice for ten seconds or until you press Enter. The copyright date serves as the version number for the DataMate.

Connector Sockets

Sensor: Socket for inclinometer control cable.

Power: Socket for battery charger or external power.

I/O: Socket for hand switch or computer interface cable.

Sockets are waterproof only when connectors are plugged in or when protective caps are in place.

KeyPad

Up: Moves cursor up. Also scrolls forward through the alphabet (a...z).

Down: Moves cursor down. Also scrolls backwards through the alphabet (z...a).

Left: Moves cursor to the left.

Right: Moves cursor to the right.

Esc: Cancels current process and returns to menu.

Enter: Chooses menu items. In record mode, records readings.

DataMate Menus

1. Use the arrow keys to select (highlight) a menu item.
2. Press Enter to choose the item or Esc to exit the item.

Main Menu

The Main menu appears when you turn on the DataMate. The Main menu shows the main functions of the DataMate.

Read	Surveys
Comm	Utilities

Your screen may show "Datasets" instead of "Surveys"

Read Menu

The Read menu lets you record inclinometer readings, edit inclinometer installation parameters, review and correct readings, and operate the readout in manual mode, which displays readings but does not record them.

Record	Installation
Correct	Manual Read

Surveys Menu

The Surveys menu lets you list the surveys that are stored in memory, validate a survey, check available memory, delete a survey, compare two surveys, and print a survey to a communications program.

Dir	Validate	Memory
Del	Compare	Print

Comm Menu

Comm puts the DataMate into communications mode for transferring data to and from a computer. Communications requires the DMM program, the included serial interface cable, and an RS232 serial port at the computer. If your computer has only USB connectors, you must use a USB-to-serial adapter or a PCM serial adaptor.

Waiting for PC . . .

Utilities Menu

The Utilities menu lets you set defaults, and check battery voltage and memory.

Batt	Beep	Light
Temp	Date	Contrast

Setting Defaults

Date and Time: Choose Date from the Utilities menu. The DataMate displays the current date and time. Press Enter to edit the date. Press Up or Down to change the year, then press Right to move the cursor to month, etc. Press Enter when done.

Beeper: Choose Beep from the Utilities menu. Press Enter to toggle the beeper on or off.

Backlight: Choose Light from the Utilities menu to switch backlight on. Choose again to switch backlight off. Backlight increases battery drain by about 12 percent.

LCD Contrast: Choose Contrast from the Press Up or Down to adjust contrast for easy viewing. Press Esc when done.

Checking the Battery

Choose Batt from the Utilities menu. A new, fully charged battery shows approximately 6.2 volts with a full charge. If the main battery drops below 6 volts, it should be recharged.

Recharging the Battery

For best performance, you should recharge the battery after every use of the DataMate. We recommend charging it over night.

Plug the charger into an AC mains socket. Plug the Lemo connector into the DataMate's Power socket. Use the Utilities - Batt function to verify that the battery is charging. You should see the voltage reading increasing.

Checking Memory

Choose Memory from the Surveys menu. The DataMate can hold readings from 2,500 depths and up to 40 Surveys.

Moisture Management

When you return to the office, remove caps from the DataMate's connectors and allow connectors to air-dry for a number of hours.

Use desiccant to keep the inside of the readout dry. This is particularly important in hot humid weather. Warm moist air trapped in the readout can condense when the readout is brought into a cool air-conditioned office.

To check the moisture level in the DataMate, choose Temp from the Utilities menu. The DataMate displays humidity and temperature. Humidity levels from 20 to 60% are normal. If humidity exceeds 75%, replace the desiccant. See instructions in the chapter on inspection and maintenance.

Setting Up Installations

Overview

Setting up the DataMate involves entering a list of inclinometer installations into the DataMate's memory. You can do this with DMM software or with the DataMate's keypad.

Setting Up with DMM Software

This method is convenient when you are in the office:

1. Use DMM to create a setup database on your PC.
2. Connect the DataMate to your PC.
3. Use DMM to transfer the setup to the DataMate.

Setting Up with DataMate Keypad

This method is convenient when you are in the field.

1. Choose Read.
2. Choose Installation.
3. Press Down key to scroll past any previously entered installations. The cursor stops on the word, "Create." Press Enter.
4. Enter the required information (see next page). To make an entry:

   Press the Right key to move the cursor into the editing zone.

   Press the Up or Down key to change the character under the cursor.

   Press the Right key to move to the next column.

   Press Enter to move to the next field.
5. To correct a mistake, press the Up or Down key to display the line that you want to correct. Then press the Right key to enter your correction.

Note 1: DataMates built before 5/2005 have a slightly different editing routine: The the cursor is automatically placed into the editing zone. The Up or Down keys have only one function: they change the character under the cursor. They cannot be used to scroll the display or move from field to field.

Note 2: The DataMate can hold a maximum of 40 installation records. If there are already 40 installation records in the DataMate, the Create command does not appear, and you cannot enter an installation.

You cannot delete installations using the DataMate keypad, but you can still record a survey, if necessary. At recording time, select any installation and change its parameters as necessary.

Installation Fields

Site & Install#: Every installation has a two-part identifier consisting of a "site" and an "installation." Enter up to 6 characters for each.

A0 dir: Enter up to 3 characters to identify the compass heading of the A grooves. Not used for any calculation, so this field is optional.

Operator: Enter up to 3 characters to identify the operator. Optional.

Sensor#: Enter the serial number of the probe. Optional, but recommended.

Sens Type: Choose Digitilt for inclinometer probes or Spiral for spiral sensors.

Units: Choose Metric or English. If you don't know, check the distance between the upper and lower wheels of the probe: 0.5 m for metric systems; 2 feet for English-unit systems.

Ins Constant: Use 25000 for metric-unit systems or 20000 for English-unit systems.

Start: Enter the starting depth for the survey. Surveys typically start at the bottom of the casing. With English-systems, it is best to use an even number so that 2-foot intervals coincide with cable markings.

End: Enter the ending depth for the survey, typically 0.5 for metric-unit systems or 2 for English-unit systems.

Interval: Enter 0.5 for metric-unit systems and 2 for English unit systems.

Check the Installations

Verify that the DataMate now holds your installation list:

1. Choose Read from the main menu.
2. Choose Installation.
3. Scroll through the list of installations.

Recording Surveys

Good Practices

1. Use the same probe and control cable for each survey, if possible.
2. Use a pulley assembly, if possible. It protects the control cable and provides a good reference.
3. Use a consistent top reference. The goal is repeatable placement of the probe within 5 mm or 1/4 inch. If one technician uses a pulley and another technician does not, probe positioning will be inconsistent, and data will be unusable.
4. Power up the probe before you insert it into the casing. Powered-up sensors resist shock better than unpowered sensors. Compress the wheels with your hand to allow smooth insertion of the probe into the casing.
5. Always wait 10 minutes for the probe to adjust to the temperature of the borehole. This helps prevent bias-shift (offset) errors.
6. Always pull the probe upward to the reading depth. If you accidentally pull the probe past the intended depth, lower it to the previous depth, then pull it back up to the intended depth. This ensures consistent placement.
7. Wait for displayed readings to stabilize. The DataMate displays 3 diamonds when readings have stabilized within two units. If the reading does not stabilize, watch the display and try to record an average reading.
8. When you remove the probe from the casing, use your hand to compress the wheels so that they don't spring free or force the body of the probe to strike the side of the casing. This helps prevent bias-shift errors.
9. Check your readings on site using the DataMate's Validate command. If necessary, reposition the probe at the required depth and using the Correct command to obtain a new reading for that depth.

Recording a Survey

1. Connect the control cable to the probe. Do not over tighten. Plug the other end of the control cable into the Sensor socket on the DataMate.

2. Switch on the DataMate. Press Enter to display the main menu.

Read	Surveys
Comm	Utilities

Your DataMate may display Datasets rather than Surveys.

3. Choose Read, then Choose Record.

Record	Installation
Correct	Manual Read

4. Choose the appropriate installation from the list.

Select Installation
SR18 IN1

5. Press Enter to step through the installation parameters without making changes. Normally, no editing is required.

Edit Installation	
Site	:SR18 IN1

Press Enter to step through these parameters

6. Finally the DataMate displays the Start depth (bottom depth).

Start depth

50.♦	204	48
Depth	A0	B0

7. Insert the probe into the casing with upper wheels in the A0 direction. Lower the probe to slightly below the start depth.

8. Wait ten minutes for the probe to adjust to the temperature at the bottom. This step is important for consistent readings.

9. Begin the survey. Raise the probe to the start depth, then watch for a stable reading. Normally, you will see three diamonds, as shown below. Press Enter to record the reading.

50.♦	206♦	52♦
Depth	A0	B0

Three diamonds ♦ ♦ ♦ indicate stable reading. Press Enter to record.

Recording a Survey continued

10.The DataMate beeps and scrolls up to the next depth. The reading just recorded is now on the bottom line. Raise the probe to the next depth (shown in the top line of the display) and wait for the numbers to stabilize. Press Enter to record the reading.

After you record the reading, pull the probe up to the next depth.

48.♦	210	55
50.*	206*	52*

Recorded readings are marked with a *

11. Repeat this process until you have recorded a reading at the top of the casing. The DataMate displays a menu. Choose Continue.

Continue	0
Done	Del

12.The DataMate now displays the starting depth for the second pass. Remove the probe from the casing and rotate it 180 degrees so that the upper wheels point to the A180 direction. Insert the probe and lower to the bottom of the casing, or slightly below the start depth.

50.♦	-210	-60
Depth	A180	B180

13.Raise the probe to the start depth, and wait for the numbers to stabilize. Press Enter to record.

48♦	-215	-75
50.π*	-210π	-60π

Recorded readings for the second pass are marked with the Pi symbol.

14.Repeat these steps until the probe is at the top of the casing and you have recorded the last reading. Choose Done from the menu, and remove the probe from the casing.

Continue	0
Done	Del

15.You may want to validate the survey using the DataMate's validate command. See Appendix 1 for instructions.

Making Corrections

If you make a mistake during the survey, you can easily correct it.

1. Use the Down key to return to the depth where the mistake was made. The depth should appear on the top line of the display.
2. Lower the probe below that depth, then pull it up to the exact depth.
3. Press Enter to make the top line active. A diamond appears next to the depth.
4. Wait for the readings to stabilize, then press Enter to record.
5. Continue recording as in a normal survey.

Cancelling a Survey

1. Press Esc. If you press Esc by mistake, press Continue.
2. Choose Del to delete the survey that you cancelled.
3. The DataMate prompts for confirmation. Press Up to confirm.

Deleting a Survey

If you want to record a survey, but the DataMate prompts "no room in memory" or "too many surveys," you must free some memory by deleting a survey.

1. Choose Surveys from the main menu.
2. Choose Del.
3. Select a survey to delete and press Enter. (Surveys marked with the ^ symbol have been retrieved by a PC, so it might be safe to delete one of them.)
4. Press Up to confirm the deletion or Esc to cancel. The DataMate deletes the survey. To avoid possible loss of data, do not switch the DataMate off during this process.

Deleting an Installation

The DataMate itself provides no way to delete installations. DMM is required for deleting installations. However, if you need to survey an installation that is not in your DataMate, you can "borrow" another installation temporarily and fix it later with DMM.

1. Go to Read - Record - and choose an installation (remember its name for later).
2. As you step through the installation parameters, change the start depth, stop depth and any other parameters.
3. Record the survey.
4. When you return to the office, upload the survey as usual. Then use DMM to create a new installation and move the survey to that installation. The How-To notes in the DMM manual show how to do this.

Retrieving Surveys

Overview

To retrieve surveys, connect your DataMate to your PC and run the DMM program. This is the normal and most efficient way to retrieve data.

Using DMM

Detailed instructions are provided in the DMM manual. The basic steps are:

1. Connect the DataMate to your PC. Choose Comm on the DataMate.
2. Start DMM and choose Retrieve Surveys.
3. Drag and drop the retrieved surveys into your project database (or export surveys to a text file).

Using a Terminal Program

You can also "print" surveys, one by one, to the DataMate I/O port and run a terminal program on your PC to receive it. This is for special purposes only.

1. Connect the DataMate to the PC.
2. Start your terminal program. Set it for 8-bit, no parity at 9600 bps.
3. Set the terminal program to "capture" or "log" the data sent from the DataMate. Specify a file name for the captured data.
4. Choose Print from the DataMate's. Set the baud rate for 9600 and press Enter. Then select the survey and press Enter to "print" it.
5. Your terminal program will usually display the readings as they are sent from the DataMate.
6. Close the file with your terminal program.

Validating Surveys

About Checksums

A checksum is the sum of 0 and 180 degree readings at the same depth. Ideally, the sum should be zero since the readings have opposite signs. In practice, variations in casing grooves, the positioning of the probe, and the bias of the sensors contribute to non-zero checksums.

In general, checksums for the A-axis should be within 10 units of the mean checksum for the A axis. For example, if the mean checksum is 5, acceptable A-axis checksums can be as large as -5 or +15. The checksums for the B-axis should within 20 units of the mean checksum for that axis.

Larger checksums may indicate that the probe wasn't positioned correctly or the reading was not stable when recorded. Larger checksums may also be caused by debris in the groove, an out-of-round casing section, a separated casing section, a wheel falling on a casing joint.

Standard Deviation of Checksums

The standard deviation of checksums can provide a quick way to confirm that the current survey is comparable to other surveys for the same borehole. Using the standard deviation in this manner requires that you establish a "typical SD" for each axis.

Obtain the "typical SD" from your initial survey. (It is good practice to make several "initial" surveys of the casing, compare them, and select one to be the official" initial.) Since the initial survey represents good readings, the standard deviation of checksums for that survey can be used as "typical SD" for that installation. Note that the "typical" is likely to be different for every installation.

When you obtain a new survey, run the DataMate's validation routine. Compare its SDs to those of the initial survey. If the standard deviation is 3 to 5 units of typical, the data is probably good. For example, if the typical standard deviation is 4, then acceptable standard deviations for subsequent surveys could range as high as 7 or 9.

Narrower limits may be appropriate for deeper installations and critical measurements. Wider limits may be appropriate for shallower installations or for poorly-installed casing.

Validating a survey

Here is a typical validation procedure:

1. Check the standard deviation of checksums. Is it typical for this casing? If so, the survey is probably good and needs no further validation. You can quit the validation routine.
2. If the standard deviation is not typical, check the standard deviation for the different zones. If any group shows an obvious problem, examine the individual checksums in that group. Also look for drifting mean checksums. A drifting mean may indicate a problem with the electronics inside the probe.
3. If you find a checksum that is too large, examine the readings at that depth to determine whether the bad reading was recorded in the 0 or the 180 orientation. Afterwards, you can correct the data by taking another reading for that depth.
4. The steps below explain this in detail.

Check the Standard Deviation

1. Choose Validate from the Surveys menu.
2. Choose a survey to validate.
3. After a short delay, you will see a display that shows both the mean (MN) checksum and the standard deviation (SD) of checksums:

```
MN  A=51.337     B=45.674
SD  A=4.1781     B=5.7170
```

4. Compare the standard deviation with the "typical" SD that you have established for the installation. If the standard deviation is acceptable, press Esc to quit. Otherwise, look at the SD for each zone.

Check Zone Statistics

1. Press Enter to view the zone with the largest SD. You will see a display that looks something like this:

```
25. - 20.      S.D.
A=3.2264       B=10.3388
```

Zone statistics include 10 readings. In this case, there are 10 half-meter readings in the zone from 25m to 20m.

2. To view the mean checksum for this zone, press the Left arrow. Press Right to redisplay the SD.
3. Press Up or Down to display other zones. Again, the Left and Right keys toggle between mean and standard deviation.
4. If you decide the survey is acceptable, press Esc to quit. Otherwise, note the zones (depths) that you want to inspect and continue.

View Individual Checksums

Follow the steps below to find depths with large checksums:

1. After viewing the checksum statistics, press Enter to view checksums. The DataMate first displays the largest checksum in the survey. In this case, the 89 in the B axis is largest.

25.	20	89
25.5	25	34
Depths	A	B

2. Use the Up and Down keys to view checksums at other depths. When you are finished viewing checksums, press Esc.

Isolating the Bad Reading

A large checksum may indicate a bad reading, but does not indicate which reading was bad (the 0 or the 180 reading?). To isolate the bad reading, you must view readings above and below the suspect reading. .

1. Choose Read from the main menu.
2. Choose Correct, then choose a survey (If necessary, press Right to see dates).
3. Press the Enter key to skip through parameters.
4. Choose 0 (orientation). Scroll through readings to the suspect depth. Check readings above and below the depth. A bad reading does not fit with the readings above and below it.
5. To view 180 readings at the same depth, press the Right arrow. Press again to display the 0 readings.
6. Note the depth and orientation of the bad reading. Then press Esc.

Correcting a Reading

1. Choose Correct from the Read menu.
2. Choose 0 or 180, and scroll the DataMate to the required depth. The depth should be displayed on the top line.
3. Lower the probe to the required depth. Wait for the probe to adjust to the temperature in the borehole (5 to 10 minutes if the probe has been in open air)
4. Press Enter to activate the reading. Press Enter again to record the reading.

Comparing Surveys

Overview

The DataMate can calculate a single value for cumulative deviation or cumulative displacement.

Cumulative Deviation

1. At the Main Menu, select "Surveys." Then select "Compare."
2. The DataMate prompts for the current survey. Press Enter to select the suggested survey or scroll to find a different survey.
3. The DataMate prompts for a "previous" survey. Press Esc since you do not want to calculate displacement.
4. The DataMate asks you to confirm a conversion value of 1. Press Enter. This will display metric data in meters and English data in feet.
5. The DataMate then calculates the cumulative deviation for the survey and displays it.
6. Press Esc to return to the Surveys menu.

Note The DataMate calculates cumulative deviation by summing incremental deviations from the bottom of the casing to the top.

If you are interested in borehole drift, you probably want the top of the borehole to be used as reference. The DataMate does not offer this as a choice, but when summing from the top, the deviation at the bottom of the borehole will be the same value except in the opposite direction.

Cumulative Displacement

To calculate displacement, the DataMate must contain two surveys for the same installation.

1. Choose Surveys from the main menu, then choose Compare.
2. The DataMate prompts for the current survey. Press Enter to select the suggested survey or scroll to find a different survey. Then the DataMate prompts for a "previous" survey. Scroll to find the initial set, then press Enter.
3. The DataMate prompts for a conversion value. Enter 1000 for a displacement in millimeters (with metric data). Enter 12 for a displacement in inches (with English unit data).
4. The DataMate then calculates the cumulative displacement for the survey and displays it. Press Esc when done.

Inspection and Maintenance

Inspection

Part	What to check for	Remedy
Desiccant	Check humidity under utilities menu.	If humidity exceeds 75%, replace or recharge desiccant.
Batteries	Check main battery and lithium battery under utilities menu.	Main battery can be recharged. If battery does not hold charge, battery can be replaced. Lithium backup battery is good for 7 to 10 years if main battery keeps charge. Return for servicing if Lithium battery is bad.
Connectors	Dirt, bent pins, o-ring	Clean with alcohol moistened swab. Note that connectors are "water proof" only when capped or when connector is plugged in.
Self Test	Error 0 or 1	Bad signal input. Return for servicing.
	Error 2 or 3	±12V sensor power. Disconnect control cable and probe. Try again. If error goes away, problem could be in probe or cable. Connect cable only. If no error, then probe is the problem. This error could also be caused by discharged battery. So try recharging battery first. If error persists, some component must be returned for servicing.
	Error 4	Main battery is low. Try recharging. If error persists, replace battery
	Error 5	Memory keep alive power is bad. Retrieve any data before switching off. Then return for service.
	Error 6	Operating temperature range exceeded. Either below -20 or above 60C.
	Error 7	Humidity above 80%. Replace desiccant.

Maintenance

Battery	Recharge battery after every use. Charge at least two hours for every hour of use. Charging overnight is common practice. Do not change longer than 72 hours. Longer charge time may damage the battery. A new, recharged battery will show 6.2V or higher. The DataMate displays a low battery warning when voltage drops to 5.5 volts. Turn off the DataMate when the warning appears and then recharge as soon as possible. Deep discharge of the main battery can reduce its performance and shorten its life.
Desiccant	Check humidity under utilities menu. If humidity exceeds 75%, replace desiccant.
Connector sockets	If it is necessary to clean the connector, use a small brush or a slim cotton swab. Do not use spray lubricants or electric contact cleaners. Solvents contained in such products will attack the neoprene inserts in the connectors.

Replacing Desiccant

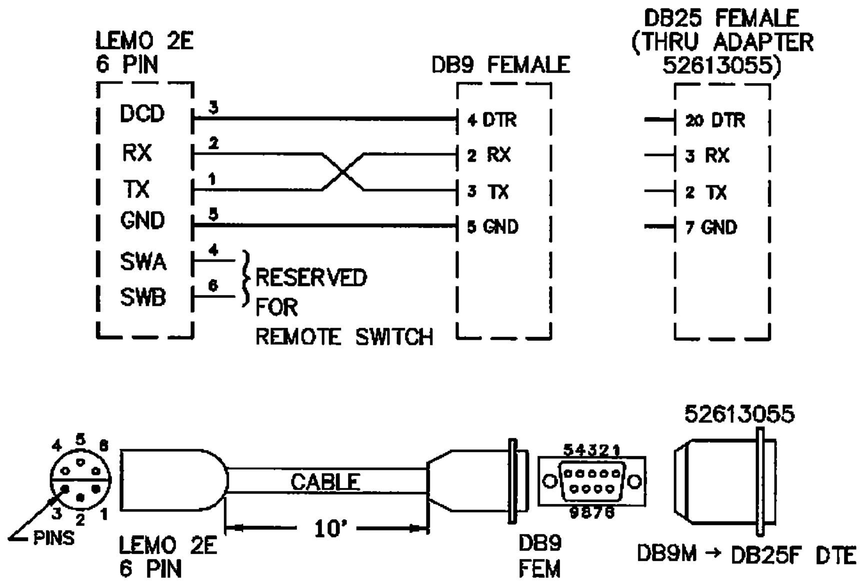
You must open the DataMate to change the desiccant. You should ground yourself to prevent a static discharge that could damage the DataMate's electronics.

Remove the two screws from the bottom of the case. Hold the top panel and pull off the case. Look for the desiccant pack between the battery and the panel connectors. Replace the desiccant pack with a new one. You may be able to renew the desiccant in an oven at 250 °F (121 °C) for 16 hours. Do not use a microwave oven to renew the desiccant. You may damage your microwave oven.

Before you replace the case, apply a light coat of silicone grease to the gasket. Also lubricate the O-rings on the screws. Then slip the DataMate back into its case, checking that the gasket is seated properly. Replace the screws and tighten to draw the top panel squarely against the case. Do not over-tighten the screws

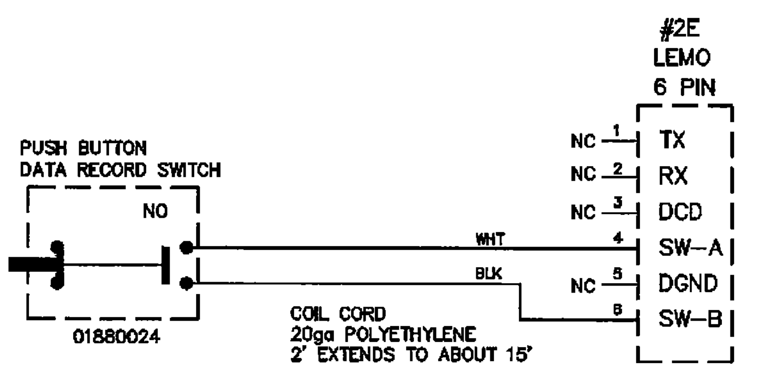
Wiring Diagram for Interface Cable

Below is the wiring diagram for the connectors on the control cable.



Wiring Diagram for Hand Switch

Below is the wiring diagram for the hand switch.



Trouble-Shooting

Tech Notes on slopeIndicator.com

Many questions can be answered by a visit to the Tech Notes section of www.slopeindicator.com. Go to Support - TechNotes. The scroll down the page to find the inclinometer tech notes. Take a look at the Digitilt DataMate Q & A page.

Readings Not Stable

The DataMate's "ready" signal is displayed when readings in both axes are stable within 2 digits. If this happens occasionally, but readings vary within 3 or 4 digits, you can record the readings with no significant loss of accuracy.

- If this problem always occurs at a single installation and at a just a few depths, it is possible that the backfill around the casing has washed away or was simply incomplete.
- In some situations, such as when there is no water in the inclinometer casing, control cable can go into a slow oscillation, shaking the probe, and preventing full stabilization of readings. The same may occur at sites where heavy construction machines are active. In this case, look for the average reading.
- Reading instability can also be caused by a low battery, so always check battery voltage before you leave the office.
- If readings always take a long time to stabilize, and this happens at all installations, contact Slope Indicator.

Strange Readings

A & B readings are midrange or higher (e.g. +6000 or -6000): Mid-range readings like this point to a cable problem. It is likely that one of the power wires is bad. The problem may be in a a broken or corroded wire in the connector.

Readings are very high, for example 12,000: If your DataMate shows a full scale reading, such as 10,000 or 12,500, when the probe is near vertical, there is probably water in the connector or in the cable.

Reading of +1786 (English) or 3125 (Metric): Typically, many readings will have this same number. This indicates an input line problem. The problem is probably in the cable or a connector. If you disconnect the signal cable, you will see the same number.

Reading of 60 or some other low number: If you see a low number that stays constant in one axis, the problem is mostly likely in the probe. The accelerometer for that axis is not working and the op amp is trying to compensate, resulting in a constant value.

GROUNDWATER INSTALLATION AND MONITORING PLAN

FOR THE

GENTILLY LANDFILL "TYPE III"

Prepared for:

AMID/METRO PARTNERSHIP, LLC
817 Hickory Avenue
Harahan, Louisiana 70123

Prepared by:

METROPLEXCORE
14423 Cornerstone Village Drive
Houston, Texas 77014

August 2006

TABLE OF CONTENTS

LIST OF ATTACHMENTS

1.0 INTRODUCTION

The Gentilly Landfill "Type III" is located at 10200 Almonaster Avenue in Orleans Parish, New Orleans, Louisiana, and is situated on top of a previously "closed" Type II landfill. The Gentilly Landfill "Type III" falls totally within the footprint of the "closed" Type II facility and accepts construction and demolition waste, wood waste, and hurricane generated materials in accordance with Louisiana Department of Environmental Quality (LDEQ) regulations.

This facility monitoring plan has been submitted in accordance with LDEQ Administrative Order No. 1036 dated April 3, 2006, and provides the location of monitor wells, well details, sampling procedures and frequencies, analytical parameters, monitoring data evaluation, and reporting procedures for site groundwater at the Gentilly Landfill "Type III". This monitoring plan will be instituted to provide an early warning of chemical changes in groundwater quality at the facility.

2.0 GROUNDWATER MONITORING

2.1 PROPOSED GROUNDWATER MONITOR WELL LOCATIONS

A series of eleven groundwater wells will be installed around the perimeter of the landfill. Figure 1 provides proposed monitor well locations. Table 1 provides the proposed groundwater monitoring system.

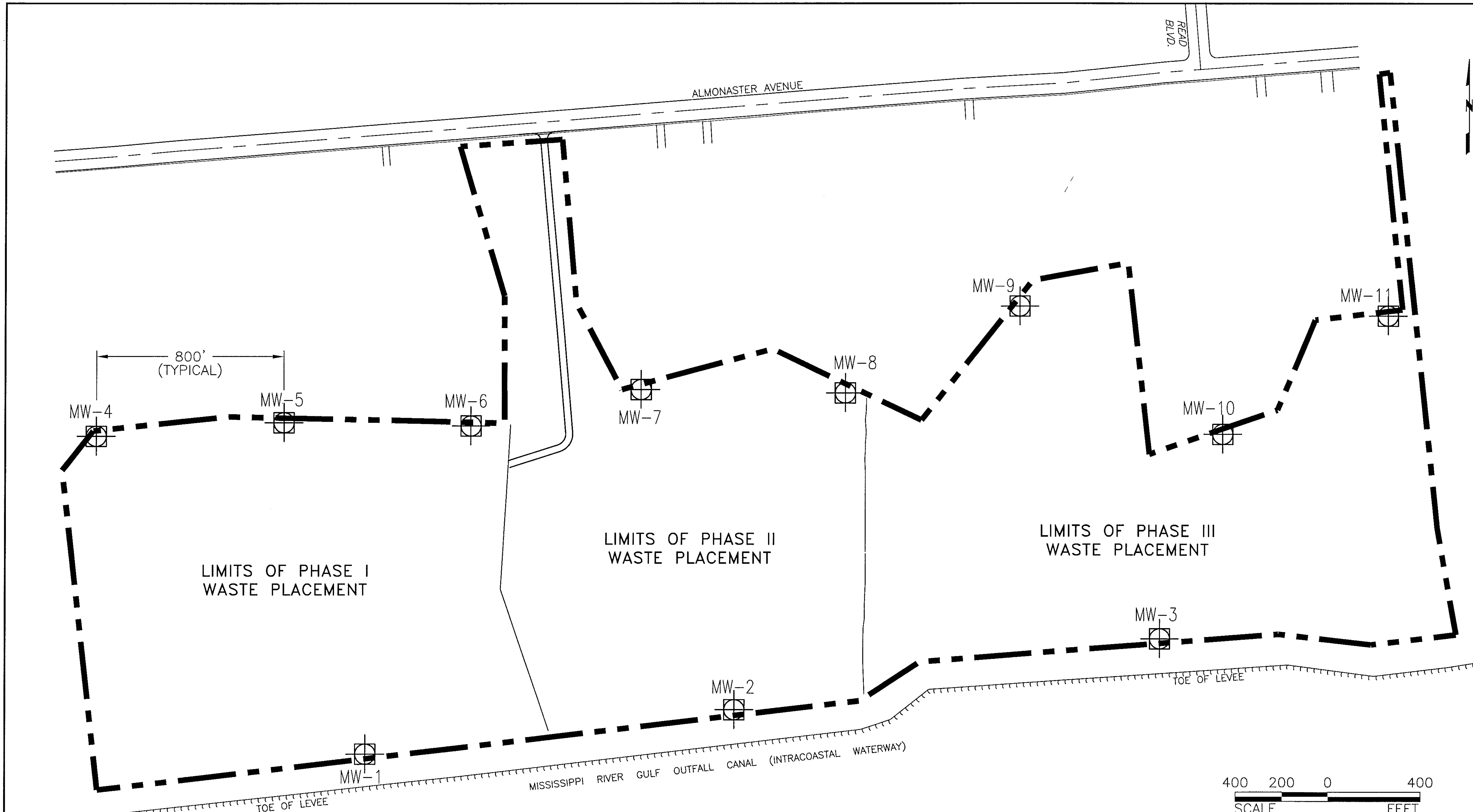
Table 1: Groundwater Monitoring System Designation and Coordinates

Well ID	Designation	Proposed Location (Northing)	Proposed Location (Easting)
MW-1	Up-Gradient	548881.19	3709496.51
MW-2	Up-Gradient	549075.04	3711079.27
MW-3	Up-Gradient	549383.94	3712915.22
MW-4	Down-Gradient	550257.81	3708341.97
MW-5	Down-Gradient	550316.91	3709144.47
MW-6	Down-Gradient	550303.28	3709943.71
MW-7	Down-Gradient	550461.36	3710676.41
MW-8	Down-Gradient	550447.48	3711557.44
MW-9	Down-Gradient	550824.01	3712311.62
MW-10	Down-Gradient	550269.13	3713188.55
MW-11	Down-Gradient	550782.23	3713904.57

Source: MII, 2006

2.2 MONITOR WELL DETAILS

The groundwater monitor well network for the site will provide for monitoring the first water-bearing strata located directly beneath the humus layer which underlies the Class II landfill. Previous borings conducted by Metroplex Industries, Inc. (MII) in 2002, Soil Testing Engineers, Inc. (STE) in 2006, and Weston in 2006 indicate that the first water bearing strata is located approximately 20-feet to approximately 35-feet below ground surface.



GROUND SURVEY DATE: 04/26/02
SURVEY DATA PROVIDED BY:

BFM
CORPORATION, L.L.C.
Professional Land Surveyors
534 WILLIAMS BOULEVARD
E-mail: bfmcorp@bfmcorporation.com
(504) 468-8800
Fax No. (504) 467-0065
CITY OF KENNER
JEFFERSON PARISH, LOUISIANA, 70062

LEGEND

PROPERTY LINE

MW-1

PROPOSED GROUND WATER MONITOR WELL LOCATION

MONITOR WELL LAYOUT

Date	Revision/Description

Drawn By	Checked By	Project No.	Dwg. Date
JCT	SO	029005-3	05/2006

GENTILLY LANDFILL "TYPE III"
ORLEANS PARISH, LOUISIANA

Metroplex core
14423 Cornerstone Village Drive
Houston, Texas 77014
Telephone: 281.440.5503
Facsimile: 281.444.3376

Figure No. 1

Monitor well screens will be 10-foot long and will be screened in the sand layer encountered beneath the humus layer. If a continuous sand layer is not encountered at a boring location, the screened section will be installed within sandy water bearing layers or seams within the underlying clay matrix. If the sandy water bearing zones within the clay matrix are not encountered at the boring location, then the monitor wells will be screened within the humus layer.

Surface casing will be utilized in each monitor well to minimize seepage from buried Class II waste placed by the previous landfill. The surface casing will consist of 8-inch PVC and extend through the waste and humus layer and terminate at the top of the monitor well screen. The surface casing will be grouted in place using cement/bentonite grout and allowed to cure prior to completion of each monitor well. Attachment 1 provides a Typical Monitoring Well Construction Detail.

Each monitor well will be installed by a contractor that has met the licensing requirements for a "contractor or driller" as set forth in Chapter 5 of the Water Well Rules, Regulations and Standards, State of Louisiana. Monitor well construction will be in accordance with the "Construction of Geotechnical Boreholes and Groundwater Monitoring Systems" prepared by the LDEQ and Louisiana Department of Transportation and Development.

2.3 WATER LEVEL MEASUREMENTS, SAMPLING FREQUENCY, AND ANALYTICAL PARAMETERS

2.3.1 Water Level Measurements

In addition to the obtaining the water level measurements during sampling events, monthly groundwater elevation measurements will be obtained from each groundwater monitoring well. One ground water elevation reading will be obtained in the morning and one ground water elevation reading will be obtained in the afternoon with at least

12 hours between each set of readings. Monthly readings will be obtained during the 6 month period after installation. Reference tide elevations representative of water level elevations within the adjacent Intracoastal Waterway will also be obtained during this period to evaluate the interconnectivity of the waterway with the site groundwater.

2.3.2 Sampling Frequency and Analytical Parameters

Ground water sampling will be conducted for a 3 year period. Baseline groundwater data will be obtained quarterly for 1 year and semi-annual for year two. Sampling parameters for Year 1 baseline and Year 2 semi-annual monitoring are provided in Tables 2 and 3 located in Attachment 2. Year 3 semi-annual sampling parameters will be selected based upon the analytical results of the first two years of groundwater sampling.

Quality assurance and groundwater sampling protocols are presented in Attachment 3.

2.4 ANALYSIS OF RESULTS

Background samples will be obtained and a trend analysis, and an upper boundary level for each parameter will be determined. This upper boundary will be the mean of the measured results of each parameter plus one standard deviation.

The results of the detection analysis will be compared to the background trend analysis for each parameter. A report identifying any parameters that exceed the upper boundary level will be provided to the LDEQ. Plots of each detected parameter over time will be presented as part of this trend analysis.

If a significant difference in groundwater quality of any down-gradient monitor well is found, further analysis of the data may be required. Should any apparent degradation of groundwater quality occur, the LDEQ will be notified within 90 days following the sampling event and the LDEQ shall determine if additional evaluation is required.

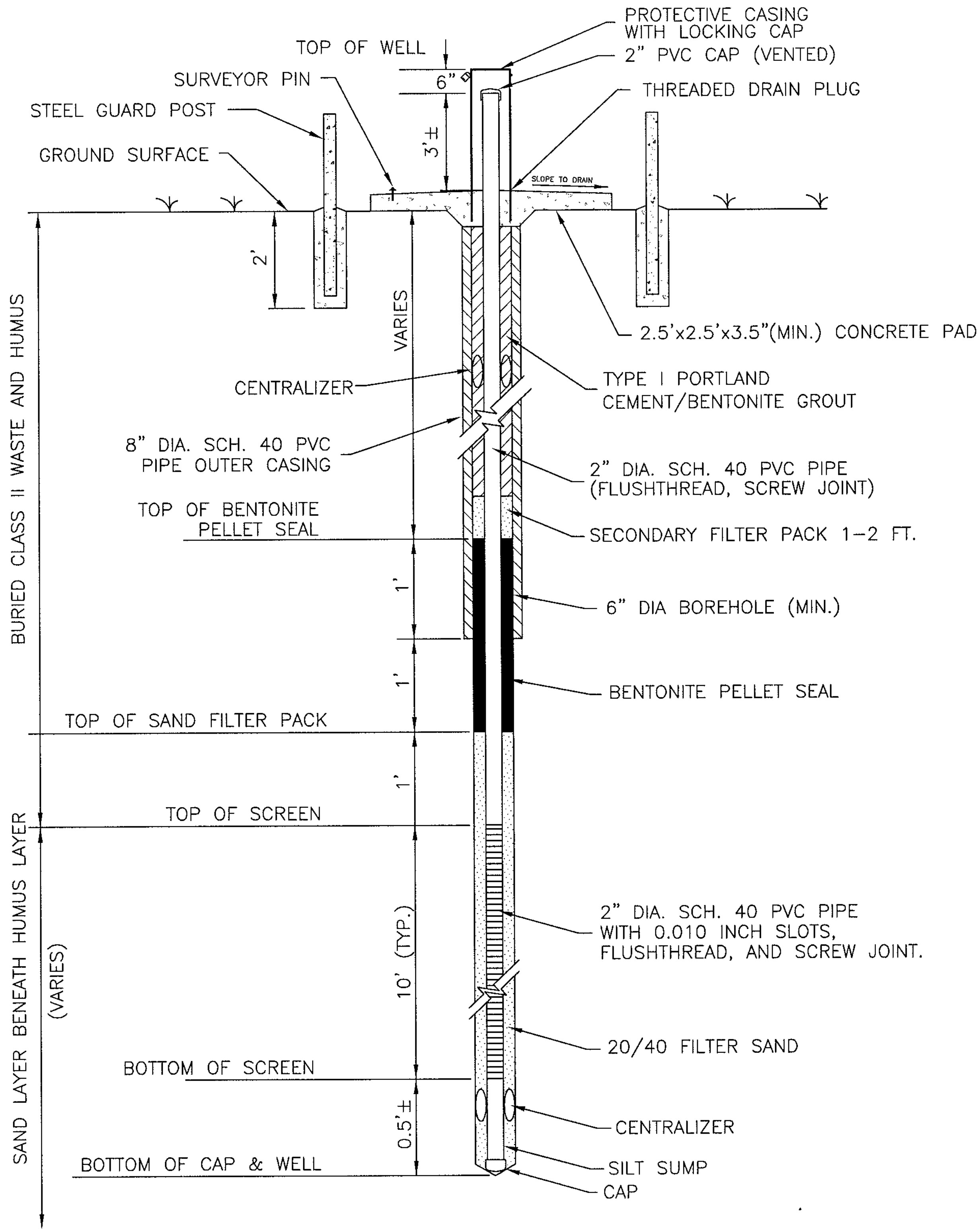
2.5 REPORTING REQUIREMENTS

A written report containing groundwater sampling results will be submitted to the LDEQ within 45 days after sample analysis have been completed, and within 90 days after the sampling date. The report will include the following information:

1. Monitor well data sheets,
2. Groundwater monitoring reports,
3. Chain-of-custody forms,
4. Laboratory analytical results,
5. Monitor well location map,
6. Monitor well construction summary,
7. Monthly and event ground water elevation data,
8. Potentiometric maps for the uppermost aquifer, and
9. Plot of trend analysis for each event after background sampling is complete.

ATTACHMENT 1

MONITOR WELL CONSTRUCTION DETAIL



N.T.S.

TYPICAL MONITORING WELL CONSTRUCTION DETAIL

Date	Revision/Description

Drawn By	Checked By	Project No.	Dwg. Date
JMT	SO	029005-3	05/2006

GENTILLY LANDFILL "TYPE III"
ORLEANS PARISH, LOUISIANA

Metroplex core

14423 Cornerstone Village Drive
Houston, Texas 77014
Telephone: 281.440.5503
Facsimile: 281.444.3376

Figure No. 2

ATTACHMENT 2

ANALYTICAL PARAMETERS

GENTILLY LANDFILL

GROUNDWATER MONITORING PARAMETERS

Table 2 -- Appendix I to Part 258—Constituents for Detection Monitoring

Year 1 and Year 2 Sampling Parameters

Common name \1\	CAS RN \2\
Inorganic Constituents:	
(1) Antimony............................	(Total)
(2) Arsenic.............................	(Total)
(3) Barium..............................	(Total)
(4) Beryllium...........................	(Total)
(5) Cadmium.............................	(Total)
(6) Chromium............................	(Total)
(7) Cobalt..............................	(Total)
(8) Copper..............................	(Total)
(9) Lead................................	(Total)
(10) Nickel.............................	(Total)
(11) Selenium...........................	(Total)
(12) Silver.............................	(Total)
(13) Thallium...........................	(Total)
(14) Vanadium...........................	(Total)
(15) Zinc...............................	(Total)
Organic Constituents:	
(16) Acetone............................	67-64-1
(17) Acrylonitrile......................	107-13-1
(18) Benzene............................	71-43-2
(19) Bromochloromethane.................	74-97-5
(20) Bromodichloromethane...............	75-27-4
(21) Bromoform; Tribromomethane.........	75-25-2
(22) Carbon disulfide...................	75-15-0
(23) Carbon tetrachloride...............	56-23-5
(24) Chlorobenzene......................	108-90-7
(25) Chloroethane; Ethyl chloride.......	75-00-3
(26) Chloroform; Trichloromethane.......	67-66-3
(27) Dibromochloromethane; Chlorodibromomethane.	124-48-1
(28) 1,2-Dibromo-3-chloropropane; DBCP.....	96-12-8
(29) 1,2-Dibromoethane; Ethylene dibromide; EDB.	106-93-4
(30) o-Dichlorobenzene; 1,2-Dichlorobenzene	95-50-1
(31) p-Dichlorobenzene; 1,4-Dichlorobenzene	106-46-7
(32) trans-1, 4-Dichloro-2-butene..........	110-57-6
(33) 1,1-Dichlorethane; Ethylidene chloride	75-34-3
(34) 1,2-Dichlorethane; Ethylene dichloride	107-06-2

(35) 1,1-Dichloroethylene; 1,1-Dichloroethene; Vinylidene chloride.	75-35-4
(36) cis-1,2-Dichloroethylene; cis-1,2-Dichloroethene.	156-59-2
(37) trans-1, 2-Dichloroethylene; trans-1,2-Dichloroethene.	156-60-5
(38) 1,2-Dichloropropane; Propylene dichloride.	78-87-5
(39) cis-1,3-Dichloropropene...............	10061-01-5
(40) trans-1,3-Dichloropropene.............	10061-02-6
(41) Ethylbenzene.........................	100-41-4
(42) 2-Hexanone; Methyl butyl ketone.......	591-78-6
(43) Methyl bromide; Bromomethane..........	74-83-9
(44) Methyl chloride; Chloromethane........	74-87-3
(45) Methylene bromide; Dibromomethane.....	74-95-3
(46) Methylene chloride; Dichloromethane...	75-09-2
(47) Methyl ethyl ketone; MEK; 2-Butanone..	78-93-3
(48) Methyl iodide; Idomethane.............	74-88-4
(49) 4-Methyl-2-pentanone; Methyl isobutyl ketone.	108-10-1
(50) Styrene..............................	100-42-5
(51) 1,1,1,2-Tetrachloroethane.............	630-20-6
(52) 1,1,2,2-Tetrachloroethane.............	79-34-5
(53) Tetrachloroethylene; Tetrachloroethene; Perchloroethylene.	127-18-4
(54) Toluene..............................	108-88-3
(55) 1,1,1-Trichloroethane; Methylchloroform.	71-55-6
(56) 1,1,2-Trichloroethane................	79-00-5
(57) Trichloroethylene; Trichloroethene....	79-01-6
(58) Trichlorofluoromethane; CFC-11........	75-69-4
(59) 1,2,3-Trichloropropane................	96-18-4
(60) Vinyl acetate........................	108-05-4
(61) Vinyl chloride.......................	75-01-4
(62) Xylenes..............................	1330-20-7

\1\ Common names are those widely used in government regulations, scientific publications, and commerce; synonyms exist for many chemicals.

\2\ Chemical Abstract Service registry number. Where ``Total'' is entered, all species in the ground water that contain this element are included.

Table 3: Water Quality Parameters

Year 1 and Year 2 Sampling Parameters

Cations

Calcium
Magnesium
Sodium
Potassium
Silica (Note 1)

Anions

Carbonate
Bicarbonate
Chloride
Fluoride
Nitrate (Note 1)
Phosphate (Note 1)
Sulfate

pH (field and lab)
Temperature (field and lab)
Conductivity
Alkalinity
Hardness

Total Dissolved Solids (TDS)
Manganese
Aluminum
Iron

Note 1 – species present under the chemical redox state in groundwater at the time of sampling

ATTACHMENT 3

QUALITY ASSURANCE SAMPLING PROTOCOLS

ATTACHMENT 3
QUALITY ASSURANCE SAMPLING PROTOCOLS

1.0 DEFINITIONS

The following definitions will be referred to throughout the Facility Monitoring Plan:

Deionized (DI) Water--Water which has been treated by passing through a standard water column and an activated carbon unit. The water contains no detectable heavy metals or inorganic compounds of analytical interest and is relatively free of organic compounds.

Tap Water--Water from an approved source which meets or exceeds U.S. Environmental Protection Agency (EPA) Drinking Water Standards.

Ultra-Pure Water--Well water that has been additionally treated through a Barnstead carbon treatment system and contains no organic compounds of analytical interest above the analytical laboratories routine detection limits.

Blind Sample--A sample labeled with a sample number but no site designation.

1.1 SAMPLE CONTAINER CLEANING PROCEDURES

Standard sample container cleaning is to be performed by the analytical laboratory following industry standards or the procedures outlined in Table 4.

Table 4: Sample Container Cleaning Procedures Within the Laboratory

Analysis/Parameter	Container Type	Matrix	Cleaning Procedure*
Organic extractables include GC/HPLC, GC/MS, and Total Phenols Analyses	Glass jar with Teflon ®-lined cap	Water	A
Organic purgeables including GC and GUMS Analyses	Glass septum vial with Teflon®-lined septum	Water	B
Metals	Linear polyethylene cubitainer with polyethylene cap	Water	C
Inorganics include BOD, COD, TOC, chloride, turbidity, sulfate	Linear polyethylene cubitainer with polyethylene cap	Water	D
O&G	Glass jar with Teflon®-lined cap	Water	A

Note:
BOD = biochemical oxygen demand.
COD = chemical oxygen demand.
GC/MS = gas chromatography/mass spectrometry.
GC/HPLC = gas chromatography/high-performance liquid chromatograph.
Glass = amber for all organic water analyses.
O&G = oil and grease.
TOC = total organic carbons.
TOX = total organic halide.

*Cleaning Protocol A B C D	Specifications
X X X	Wash with hot tap water using laboratory-grade, nonphosphate detergent.
X X X	Rinse 3 times with tap water.
X X	Rinse with 1:l nitric acid (reagent-grade nitric acid diluted with ASTM Type I deionized water).
X X X	Rinse 3 times with ASTM Type 1 deionized water.
X	Rinse with pesticide-grade methylene chloride using 20 mililiters (mL) per 64-oz bottle, 10 mL per 32- or 16-oz bottle, or 5 mL per 8- or 4-oz bottle. Methylene chloride is used as organics rinse.
X X	Oven dry, using a forced air oven, at 105 degrees (") to 125 degrees Celcius ("C) for 1 hour.
X	Invert and air dry in contaminant-free environment
X	No cleaning required; use new cubitainers (only).

Source: MII, 2006

1.2 FIELD DECONTAMINATION

The following decontamination procedures will be used on all equipment that contacts the sample matrices:

Dedicated equipment, which is left inside monitor wells between sampling events, need only be decontaminated during the initial round of sampling unless equipment has been dropped on unprotected ground surfaces. The following procedure will be used for the decontamination of bailers and other equipment, which will be used directly to obtain water quality samples for organic compounds and metals analysis:

1. Clean with Liquinox detergent wash, or equivalent, and tap water using a brush, if necessary, to remove particulate matter and surface films;
2. Rinse thoroughly with tap water;
3. Rinse thoroughly with 10 percent nitric acid (HNO3,);
4. Rinse thoroughly with DI water;
5. Rinse twice with pesticide-grade isopropanol;
6. Allow to air-dry; and
7. For overnight storage, wrap in new aluminum foil, if appropriate, to prevent contamination.

The following procedure will be used for the decontamination of all purging and monitoring equipment including submersible pumps, airlift systems, and pneumatic bailer systems:

1. Rinse elevation tapes with Liquinox detergent wash, tap water rinse, followed by DI water rinse. Place equipment in polyethylene bags to prevent contamination during storage or transit.
2. Rinse tubing, hoses, and pumps with a liquinox detergent wash, tap water rinse followed by a DI water rinse.

3. If the inside of the tubing hoses cannot be rinsed adequately, tap water and DI water should be pumped through the tubing.

1.3 GROUNDWATER SAMPLING PROTOCOLS

The following procedures will be used in the collection of groundwater samples:

1. Immediately prior to purging a well, the static water level below the top of well casing and total depth of well will be measured and recorded in the field notebook to the nearest 0.01 foot.
2. Prior to purging the wells, the volume of water in the well, will be calculated based on the static water level and the well construction information.
3. Conductivity and pH meters will be calibrated in accordance with manufacturer's instructions and documented on the calibration forms. Examples of calibration forms are provided on Figures 3 and 4, respectively.
4. The monitor well will be purged a minimum of 3 volumes of water using a submersible pump, bailer, airlift system, pneumatic bailer, PVC bailer, or other device until the water temperature, pH, and conductivity of the water have stabilized.
5. Extremely slow recharging wells will be purged dry, allowed to recharge, and purged again. If excessive time is required to purge 3 volumes, Amid/Metro (and/or LDEQ) will be notified and it may be agreed to purge a lesser volume. The total amount of fluid purged will be measured and recorded.
6. Monitor wells will be sampled using a dedicated, decontaminated bailer or new, decontaminated disposable bailer.

7. All sampling equipment will be protected from contaminated soil surfaces to prevent cross contamination of the samples (e.g., equipment may be placed on disposable polyethylene plastic sheeting).
8. The bailer will be rinsed once with well water (first bail is discarded) prior to collecting a sample.

Prior to monitor well sampling, the following data will be noted and recorded in the sampling notebook:

1. Well number,
2. Date,
3. Time,
4. Static water level,
5. Depth of well,
6. Volume of water purged,
7. In situ water quality measurements (temperature, specific conductivity, and pH),
8. Fractions sampled and preservatives,
9. Antecedent weather conditions,
10. Any other pertinent observations (color, odor, turbidity, etc.), and
11. Signature of sampler and date.

An example of a groundwater sampling form is shown on Figure 5. To determine the effectiveness of the decontamination procedures, an equipment blank will be processed in the field. A representative piece of sampling equipment, which has been decontaminated and dried, will be rinsed with ultra-pure water obtained from the laboratory. The rinse water is collected in sample bottles, preserved, and handled in the same manner as the water quality samples. Dedicated sampling equipment will be tested only at the time of initial installation.

Sample duplicates are collected to assure the precision of the sampling and analytical processes. For sampling events at this site only one duplicate will be obtained for each event. Each duplicate will be a blind sample; therefore, it is critical for the field team to record the sample number and site identification in the field notes. The representative sample fraction of the analytical sample and the associated duplicate must be sampled to assure that both samples represent the matrix being sampled.

Trip blanks are used for purgeable compounds and consist of sample bottles filled in the laboratory with ultra-pure water, which are sent to the sampling location with sampling kits. The trip blanks, not opened in the field, are returned from the site with the field samples. The trip blanks are analyzed with each shipment from the field. A summary of blank and duplicate requirements for a typical sampling event is included in Table 5.

1.4 SAMPLE CHAIN-OF-CUSTODY AND HANDLING

The primary objective of sample chain-of-custody is to create an accurate written verified record, which can be used to trace the possession and handling of the samples from the moment of collection until receipt by the laboratory. Adequate sample custody will be achieved using an approved chain-of-custody form. An example of an approved chain-of-custody form is provided as Figure 6.

The chain-of-custody form includes:

1. The unique sample number as obtained from the sample label;
2. Source of the sample;
3. Date and time of sample collection;
4. Name(s) of collector(s); and
5. Optional field data (pH, temperature, and specific conductance).

Samples are preserved and placed in a hard-sided cooler along with sufficient quantities of ice to maintain the samples at a temperature of 4°C. Each sample fraction shipped must be noted on the chain-of-custody form. The logsheet is placed in a sealable plastic food storage bag and sealed in the cooler along with the appropriate samples. The seals on the coolers will not be broken until the samples arrive in the analytical laboratory and are checked in by the laboratory coordinator or designate.

Table 5: Blank and Duplicate Requirements for a Typical Sampling Event

Analytical Group	Number of Samples	Number of Duplicate Samples	Number[1] of Equipment Blanks	Trip[2] Blank
All parameters	11	1	1	1

Source: MII, 2006

1. Only for initial event if dedicated equipment is used.
2. Trip Blank only if Volatile Organic Compounds are analyzed.

FIGURE 3: CONDUCTIVITY METER CALIBRATION FORM

Project: ______________________ Date: ______________
Meter: ______________________ Standards Temp.: ______________
Is meter temperature compensated? ___ Yes ___ No

Manual Correction to 25°C

$$C_{25} = \frac{CK}{1+0.0191(t-25)}$$ where

C = meter reading (uncompensated)
T = solution temperature (°C)
K = Cell constant = 1 (most probes)

Time: ______________________ Signature: ______________________

	Standard (µmhos/cm)	Meter Reading	Meter Reading @ 25°C	% Error* Std-Meter @ 25°C / Std (100)
1.)				
2.)				
3.)				

Time: ______________________ Signature: ______________________

	Standard (µmhos/cm)	Meter Reading	Meter Reading @ 25°C	% Error* Std-Meter @ 25°C / Std (100)
1.)				
2.)				
3.)				

Time: ______________________ Signature: ______________________

	Standard (µmhos/cm)	Meter Reading	Meter Reading @ 25°C	% Error* Std-Meter @ 25°C / Std (100)
1.)				
2.)				
3.)				

Time: ______________________ Signature: ______________________

*Should be less than 10.

Signature: ______________________
Field Team Leader

FIGURE 4

pH METER CALIBRATION FORM

Project: ____________________ Date: ____________________

Meter: Thermometer No.:

Buffer Solution

	Time (24-hour system	Meter Reading				Buffer Temp. (°C)	% Slope	Operator
Initial		Unadjusted						
Calibration		Adjusted						
		Unadjusted						
		Adjusted						
		Unadjusted						
		Adjusted						
		Unadjusted						
		Adjusted						
Intermediate Calibration		Unadjusted						
		Adjusted						
		Unadjusted						
		Adjusted						
		Unadjusted						
		Adjusted						
		Unadjusted						
		Adjusted						
Final		Unadjusted						
Calibration		Adjusted						

Intermediate checks may be made with one buffer (unadjusted reading); if readings are within 0.1 unit of the standard, no calibration adjustment is made; if greater than 0.1 unit, a complete calibration is necessary (adjusted readings); if greater than 0.2 unit, increase frequency of intermediate checks.

Signature: ____________________
Field Team Leader

FIGURE 5

WELL SAMPLING DATA FORM

Well Number: ____________ Date: ____________ Time: ______________

Boring Diameter: ______________ Well Casing Diameter: ______________________________

Well Depth: __________________________ Stickup: ______________________________

WATER LEVEL

Held: ____________

Cut: ____________

DTW: ____________ Top of Casing

COLUMN OF WATER IN WELL

Casing Length: ____________

DTW Top of Casing: ____________

Column of Water in Well: ____

VOLUME TO BE REMOVED

Gallons per foot of Casing = __________

Column of Water, ft X __________

Total Volume of Casing = __________

Number of Volumes to be Evacuated X __________

Total Volume to be Evacuated, gal = __________

Method of Purging (pump, bailer, etc.): ____

FIELD ANALYSES	Start	Mid	End
Time	________	________	________
pH	________	________	________
Conductivity	________	________	________
Temperature	________	________	________

Total Volume Purged: ____________ gallons

Sample Time: ______________ Sample Number: ______________

NOTES

Signed/Sampler: ____ Date: ______________

Signed/Reviewer: ____ Date: ______________

Figure

FIGURE 6

CHAIN-OF-CUSTODY LOG SHEET

MetroplexCore
*** Field Logsheet ** Field Group:
Project Number: Project Name: Lab
Coord.:

MII #	SITE/STA NOTES	HAZ?	FRACTIONS	DATE	TIME	PARAMETER LIST
1	TEST 1					
2						
3						
4						
5						

NOTE:

- Changc or enter site ID as necessary; up to 9 alphanumeric characters may be used
- List fractions collected. Enter date, time, field data (if required), hazard code, and notes
- Hazard codes: I=Ignitable C=Corrosive R=Reactive T=Toxic Waste h=Other Acute Hazard; identify specifics if known
- Please return log sheets with samples to MII

RELINQUISHED BY: (Name/Organization/Date/Time)	RECEIVED BY: (Name/Organization/Date/Time)
1	
2	
3	

OTHER FIELD NOTES FOR FIELD GROUP

SAMPLING PROTOCOLS AND ANALYSIS PLAN FOR SHALLOW SURFACE WATER SAMPLING PORTS GENTILLY“TYPE III” LANDFILL ORLEANS PARISH, LOUISIANA

The following procedures will be used in the collection of surface water samples from the three shallow surface water sampling ports:

1. Samples will be obtained from three locations, as indicated on Figure 5.
2. Sampling will be obtained quarterly for a period of three years;
3. The sampling locations will be Cased Sampling Ports, consisting of PVC pipe with screened interval from 3 to 8 feet below existing grade;
4. LDEQ will be notified at least five working days prior to all field work;
5. Immediately prior to purging a cased sampling port, the static water level below the top of cased sampling port casing and total depth of cased sampling port will be measured and recorded in the field notebook to the nearest 0.01 foot;
6. Prior to purging the cased sampling ports, the volume of water in the cased sampling port, will be calculated based on the static water level and the cased sampling port construction information;
7. pH meters will be calibrated in accordance with manufacturer's instructions and documented on the calibration forms;
8. The cased sampling port will be purged a minimum of 3 volumes of water using a submersible pump, peristaltic pump, bailer, airlift system, pneumatic bailer, PVC bailer, or other device;
9. Extremely slow recharging cased sampling ports will be purged dry, allowed to recharge, and purged again. If excessive time is required to purge 3 volumes, AMID/METRO (and/or LDEQ) will be notified and it may be agreed to purge a lesser volume. The total amount of fluid purged will be measured and recorded;

6. Samples will be obtained using a dedicated, decontaminated bailer, peristaltic pump, new decontaminated disposable bailer, or other suitable device;
7. All sampling equipment will be protected from contaminated soil surfaces to prevent cross contamination of the samples (e.g., equipment may be placed on disposable polyethylene plastic sheeting).

Prior to sampling, the following data will be noted and recorded in the sampling notebook:

1. Cased sampling port number,
2. Date,
3. Time,
4. Static water level,
5. Depth of cased sampling port,
6. Volume of water purged,
7. In situ water quality measurements (pH),
8. Antecedent weather conditions,
9. Any other pertinent observations (color, odor, turbidity, etc.), and
10. Signature of sampler and date.

CHAIN-OF-CUSTODY AND HANDLING

The primary objective of chain-of-custody is to create an accurate written verified record, which can be used to trace the possession and handling of the samples from the moment of collection until receipt by the laboratory. Adequate sample custody will be achieved using an approved chain-of-custody form.

The chain-of-custody form includes:

1. The unique sample number as obtained from the sample label;
2. Source of the sample;
3. Date and time of sample collection;
4. Name(s) of collector(s); and

5. Optional field data (pH).

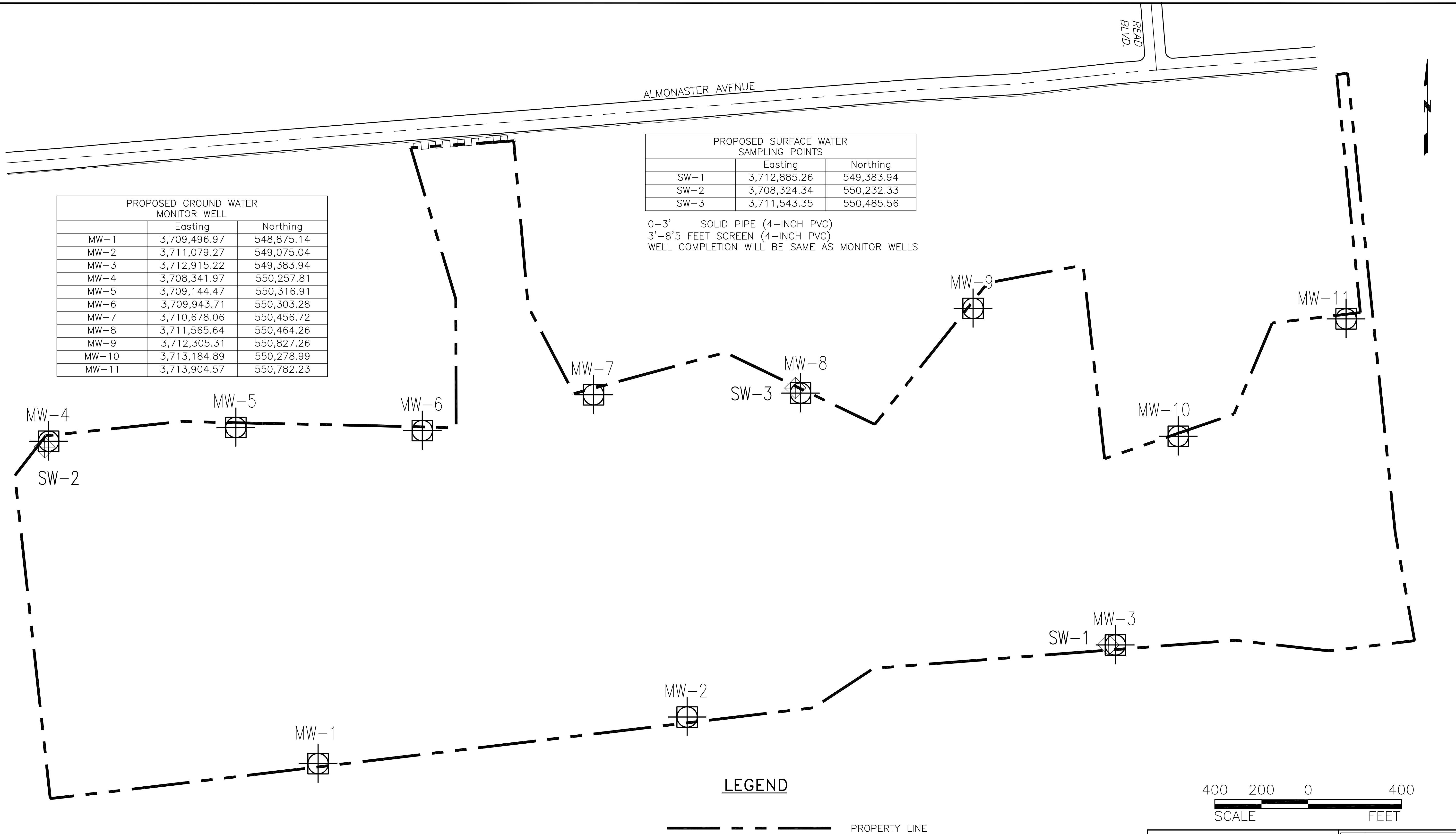
Samples are preserved and placed in a hard-sided cooler along with sufficient quantities of ice to maintain the samples at a temperature of 4°C. Each sample fraction shipped must be noted on the chain-of-custody form. The logsheet is placed in a sealable plastic food storage bag and sealed in the cooler along with the appropriate samples. The seals on the coolers will not be broken until the samples arrive in the analytical laboratory and are checked in by the laboratory coordinator or designate.

ANALYSIS

Samples will be obtained on a quarterly basis for three years and will be analyzed for the following parameters:

Parameter	Limit
Biochemical Oxygen Demand (5-day)	140 milligrams per liter (mg/l)
Total Suspended Solids	88 mg/l
Ammonia (as N)	10 mg/l
alpha-Terpineol	0.033 mg/l
Benzoic acid	0.12 mg/l
p-Cresol	0.025 mg/l
Phenol	0.026 mg/l
Zinc	0.20 mg/l
pH	6 to 9 mg/l

If the limits are exceeded in any event, the LDEQ will be notified and re-sampling will be performed within 14 days. After results of re-sampling are available, the Department shall determine if additional evaluation is required.



PROPOSED GROUND WATER MONITOR WELL		
	Easting	Northing
MW-1	3,709,496.97	548,875.14
MW-2	3,711,079.27	549,075.04
MW-3	3,712,915.22	549,383.94
MW-4	3,708,341.97	550,257.81
MW-5	3,709,144.47	550,316.91
MW-6	3,709,943.71	550,303.28
MW-7	3,710,678.06	550,456.72
MW-8	3,711,565.64	550,464.26
MW-9	3,712,305.31	550,827.26
MW-10	3,713,184.89	550,278.99
MW-11	3,713,904.57	550,782.23

PROPOSED SURFACE WATER SAMPLING POINTS		
	Easting	Northing
SW-1	3,712,885.26	549,383.94
SW-2	3,708,324.34	550,232.33
SW-3	3,711,543.35	550,485.56

0-3' SOLID PIPE (4-INCH PVC)
3'-8'5 FEET SCREEN (4-INCH PVC)
WELL COMPLETION WILL BE SAME AS MONITOR WELLS

LEGEND

PROPERTY LINE

MW-9 PROPOSED GROUND WATER MONITOR WELL

SW-2 PROPOSED SURFACE WATER SAMPLING POINT

GROUND SURVEY DATE: 04/26/02
SURVEY DATA PROVIDED BY:
BFM CORPORATION, L.L.C.
Professional Land Surveyors
534 WILLIAMS BOULEVARD
E-mail: bfmcorp@bfmcorporation.com
(504) 468-8800
Fax No. (504) 467-0065
CITY OF KENNER
JEFFERSON PARISH, LOUISIANA, 70062

MONITOR WELL LAYOUT

Date	Revision/Description		
Drawn By	Checked By	Project No.	Dwg. Date
JCT	SO	029005-3	08/2006

GENTILLY LANDFILL "TYPE III"
ORLEANS PARISH, LOUISIANA

Metroplex core
14423 Cornerstone Village Drive
Houston, Texas 77014
Telephone: 281.440.5503
Facsimile: 281.444.3376

Figure No. 5